SPACE SOCIETY IST PRESENTS

2026 EDITION, VOLUME 02

THE COSMIC HERALD

LINKING REALMS

NIGHT SKY

SPACE GALLERY & DARK SKY INITIATIVES

SPACE POLITICS & FRONTIERS

MARS EXPLORATION & SPACE WARS

ASTROBIOLOGY & ORIGINS

WE ARE ALL MADE OF STARDUST & MARTIAN MICROFACTORY

CINEMA & CULTURE

BEYOND THE BLUE

QUANTUM & DEEP SPACE

INTERVIEWS, REVIEWS & ARTWORK

STORIES. IDEAS. PEOPLE.

QUANTUM ENTANGLEMENT, BOÖTES VOID & DARK MATTER UNVEILED

INSTITUTE OF SPACE TECHNOLOGY

INSPIRING MINDS • EXPLORING FUTURES

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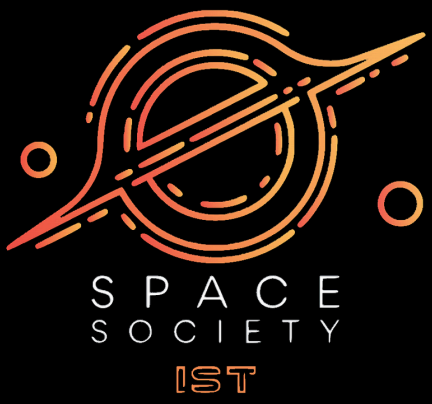
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MACH

FOREWORD

It gives me great pleasure to present the second volume of Cosmic Herald, the magazine of the Space Society at the Institute of Space Technology. Its return after a gap of several years is more than the revival of a publication; it reconnects us with an earlier student initiative and carries that legacy forward through a new generation of curious and creative minds.

At the Department of Space Science, we believe that education extends far beyond lectures, laboratories, and examinations. It also involves asking meaningful questions, communicating complex ideas clearly, and exploring the relationship between science, technology, society, and imagination. Cosmic Herald provides our students with a valuable platform to do precisely that. The diversity of this volume is particularly encouraging. Its pages bring together astronomy, space technology, planetary science, artificial intelligence, Earth and climate studies, numerical research, astrophotography, literature, and art. This breadth reflects the truly interdisciplinary nature of space science. It also demonstrates that scientific understanding is strengthened when technical knowledge is combined with creativity, critical thinking, and effective communication.

I warmly congratulate the editorial team, the office bearers and members of the Space Society, the faculty mentors, and all contributors who devoted their time and abilities to bringing this ambitious volume to completion. I hope that the publication of Volume II marks the beginning of a continuous and enduring tradition. May future students build upon it, introduce new perspectives, and ensure that Cosmic Herald continues to serve as a record of the intellectual energy and creative spirit of the IST community. Every journey of discovery begins with curiosity and the courage to look beyond familiar boundaries.

Dr. Sajid Ghuffar
Head, Department of Space Science
Institute of Space Technology

EDITOR'S NOTES

"Do, what you love,
love what you do."

The making of Cosmic Herald Volume II has been an experience of practically living this motto, which has been handed down to me as the magazine's current editor, and the second that it has had since its inception. Across a year and a half, from inception, submissions, revisions, through to careful design and copy editing, this magazine slowly took shape and is finally seeing the light of day!

In a world that moves ever faster, creating something gradually, thoughtfully, and by hand has been rewarding work, but also a veritable act of resilience.

There's an analogy that reads, "Humans are like musk deer, they search for a scent that is already within them"; paradoxically we look for a connection outside that is already part of our being.

Imagine a world where no human is conscious enough to ask *why*? No one to put names to stars or to stand still watching the moon, no one waiting for a once-in-a-while sky event, none taking an early morning stroll to catch the sunrise, or the planets passing in parade with no one to applaud them, no ancient minds to map the heavens, or trace the celestial bodies; a world where we never build giant monsters that send signals and bring the stunning images before our eyes in less than a blink.

Humans do love to question, so here's another one:
In a universe without us to witness it,
will that vast, infinite matter... truly matter?

This August, we bring you various articles inspired by our subtle connection to the cosmos, emerging from the time when we collected articles and they organically, and not surprisingly, took the shape of the pieces of an unfinished puzzle of the universe.

In the pages to follow, you'll be able to see the literal connections, the invisible bonds and silent influences, the energy we resonate consciously and subconsciously, and the primordial image upon which rests today's innovation in research and technology, taking us to the yet–unknown.

This volume rekindles the very purpose of the first volume; we refused to let it fade and we hope it paves the way for new ventures. It exists because of the people who are passionate, who wonder, and create. May these pages remind you of that origin of connection, broaden your horizons, inspire you to know more, and perhaps make you feel a little more ***at home with the cosmos.*** The Cosmic Herald is the reader's own place in space that offers just the right kind of proximity to be curious and to wonder.

We should stand in awe.

Izza Fatima Hassan

Editor

You deem yourself a small entity, but within you is enfolded the entire universe

Imam Ali ibn Abi Talib (a.s.), *Diwan Ameer al-Mu'minin*

Image Credit: NASA, ESA, CSA, STScI (JWST Deep Field)

PRESIDENT'S NOTE

There is something special about looking up at the night sky. Every star reminds us that curiosity is where every great journey begins. Long before we reached space, we imagined it—and every discovery since has started with a simple question: What lies beyond?

That same curiosity is what inspired Cosmic Herald.

This magazine is a collection of the ideas, creativity, and passion of our student community.

Within these pages, you'll find research, interviews, astrophotography, artwork, and stories that celebrate not only space, but the people who choose to explore it in their own unique ways.
Creating this edition has been a collaborative journey, and I'm grateful to every writer, editor, designer, photographer, and volunteer who helped bring it to life.

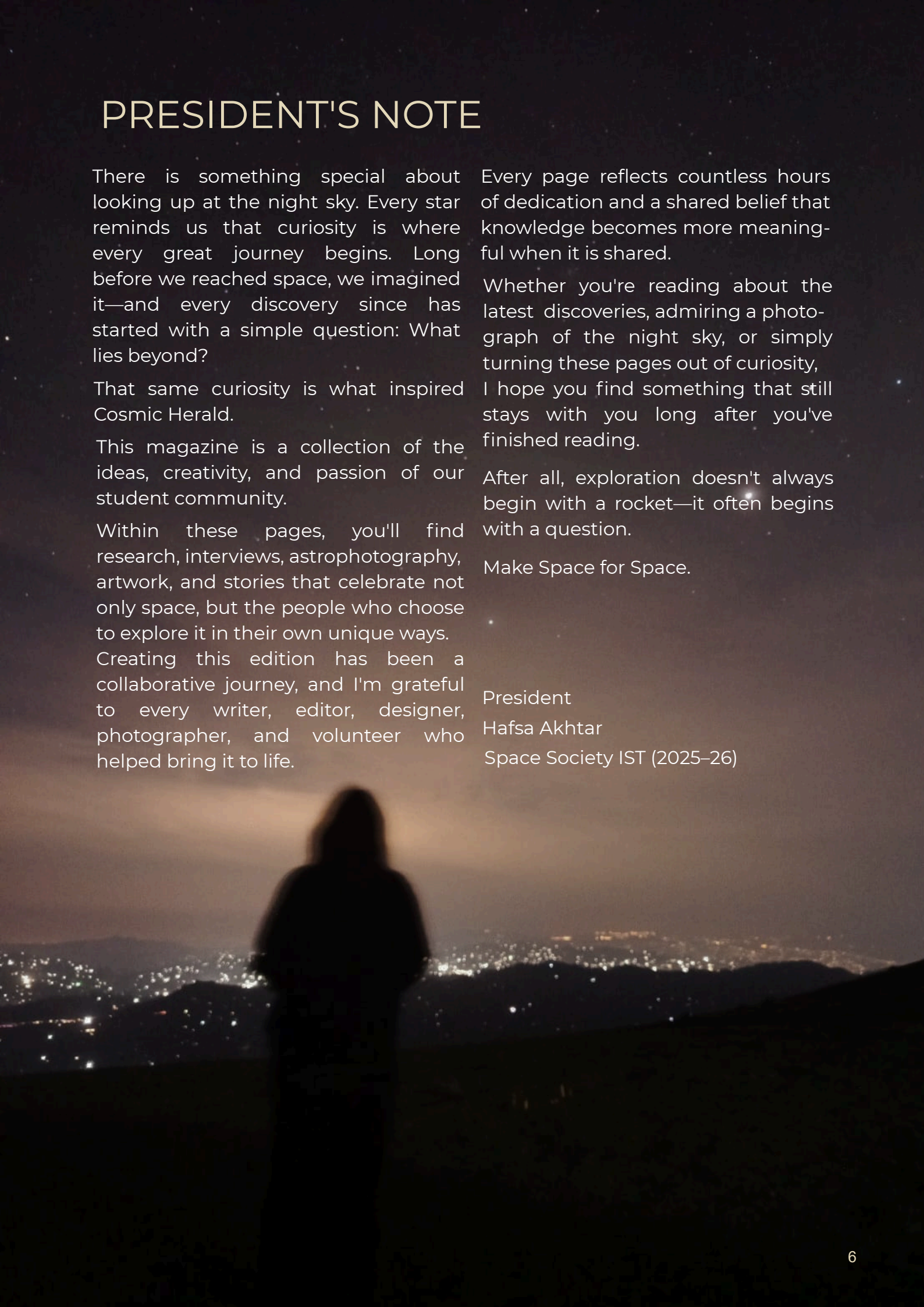
Every page reflects countless hours of dedication and a shared belief that knowledge becomes more meaningful when it is shared.

Whether you're reading about the latest discoveries, admiring a photograph of the night sky, or simply turning these pages out of curiosity,
I hope you find something that still stays with you long after you've finished reading.

After all, exploration doesn't always begin with a rocket—it often begins with a question.

Make Space for Space.

President
Hafsa Akhtar
Space Society IST (2025–26)



THE MASTHEAD

The Minds Shaping Our Cosmic Narrative

This issue was made possible through the dedication, intellect, and passion of the following individuals, to whom we are grateful for their time, skill, and energy that went into making this project a reality:

FACULTY PATRON

Dr Imran Ali Khan

The Sun is our nearest cosmic laboratory.

Assistant Professor,
Space Science Department

Ms Tamkeen Zehra Shah

Under the sheer weight of all that we don't know, every discovery is a small miracle.

Lecturer, Humanities & Sciences Department

FACULTY EDITOR

EDITOR-IN-CHIEF

Keep sailing, and let the stars guide

Izza Fatima Hassan

MANAGING EDITOR

Rayyan Sagheer

PRESIDENT

The future of planetary science belongs to those willing to keep asking bigger questions.

Hafsa Akhtar

Vice PRESIDENT

Stand before the vastness of space, and let it teach you humility!!

Talha Zubair

DESIGN LEAD

Showing the beauty of space through art.

Amna Zaidi

ASSOCIATE DESIGNER

What's out there?

Sibgha Anwar

COVER DESIGN / General Secretary

In the vastness of the void, where there are no boundaries to dreams

Haider Taqveen

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Izza Fatima Hassan, Hafsa Akhtar & Talha Zubair

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Abeer Zeb, Ume Aymen

HONORABLE MENTIONS

Space Society IST is a student-led platform advancing space science, rocketry, and aerospace through hands-on technical initiatives. This magazine captures that journey, translating experiments, designs, and breakthroughs into stories that inspire everywhere. A huge thanks to our faculty, especially Faculty Editor Ms. Tamkeen Zehra Shah, for her continued dedication to this volume and for enriching this magazine with her invaluable insights. We are deeply grateful to all the members, contributors, and supporters whose passion makes this vision possible.

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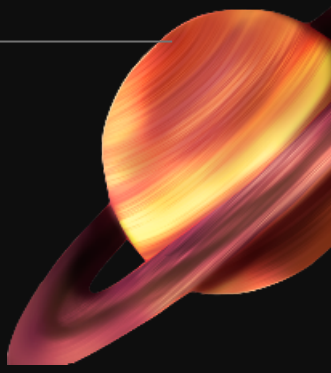

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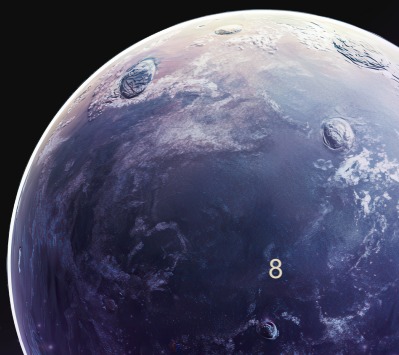


CONTENTS

THE NIGHT SKY

12 OBSESSED WITH THE MOON
Dive into insights from Darya Kawa Mirza on capturing our closest cosmic neighbor.

15 INTERVIEW: ASTROPHOTOGRAPHY
Roshaan shares the setup and patience needed for astrophotography.

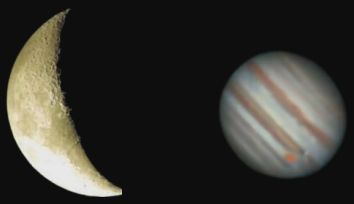
18 SPACE GALLERY
A surreal gallery of selected astroimages from Roshaan's lens, presenting a great view of the sky and its cosmic objects.

92 OBSERVING HIGHLIGHTS OF 2026
Following last year's Blood Moon, your definitive skywatching guide to 2026's signature transits lighting up the Northern Hemisphere this year.

70 SEA YOU ABOVE
As light pollution spreads worldwide, Zaid Ali reveals its heavy toll on both the skies above and the sea below.

72 DARK SKY: PAKISTAN CHAPTER
Preserving our window to the cosmos.

94 ASTRO WALK HIGHLIGHTS
Cold nights, warm tea, and quiet wonder.



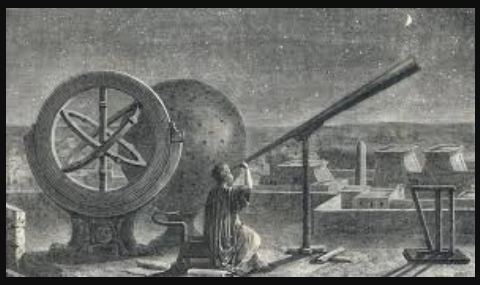
SPACE DEVELOPMENT

30 ARCS: Active Retry Control System
How do we ensure a tiny, frozen satellite's solar panels open safely? Imama Fatima explains the clever backup logic.

36 CHALLENGES FACED BY REUSABLE ROCKETS
Landing a giant rocket on the ocean defies physics; Dawood breaks it down.

41 SPACE ARCHITECTURE
Beyond bricks and mortar, Sibgha shares a safe, visionary look at extraterrestrial habitats.

47 MARTIAN MICROFACTORY
Sami Ur Rehman explores compact, automated synthetic biology systems engineered for Martian survival.



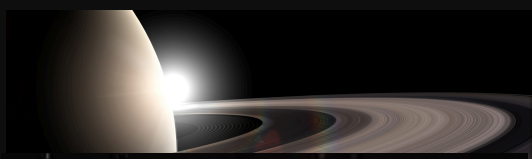
DETAILED ARTICLES

32 ORBITAL DOMINANCE OR SPACE WARS
Syed Zain opens our eyes to how modern politics rise into orbit.

21 ANCIENT INTERPRETATIONS OF THE COSMOS
Rayyan shares how early civilizations wove stars into myth.

59 NUMERICAL SOLUTIONS TO THE LAW OF UNIVERSAL GRAVITATION FOR A TWO-BODY SYSTEM
Building on Volume One's foundational calculus, Zain Ul Abideen introduces computer-coded planetary simulations.

62 NUMERICAL SOLUTIONS TO THE ONE-DIMENSIONAL HEAT EQUATION
Discover the math that keeps spacecraft hulls from melting.



FEATURE

28 WE ARE ALL MADE OF STARDUST
The iron in your veins was forged inside a dying star, as Areeba shares in this beautiful reflection.

43 BOÖTES VOID
Is space completely full? Haris takes us to explore a massive empty hole in the cosmic fabric.

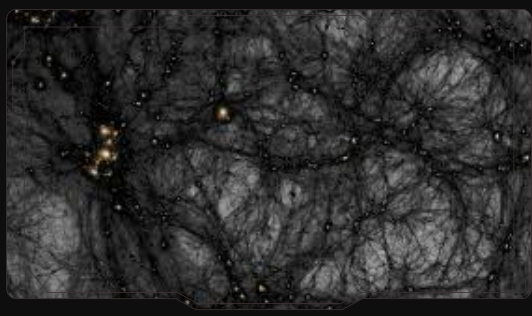
50 QUANTUM ENTANGLEMENT
Beyond the Speed of Light: Tahir reveals how Non-Local Physics Rewrites Our Reality.

57 INBOUND
Moving past Saturn's iconic hexagon from our last volume, Qurat-ul-Ain explores J1407b's colossal, dust-filled ring system.

53 IS THE THEORY OF EVERYTHING POSSIBLE?
Maryam Ali guides us through the holy grail of theoretical physics.

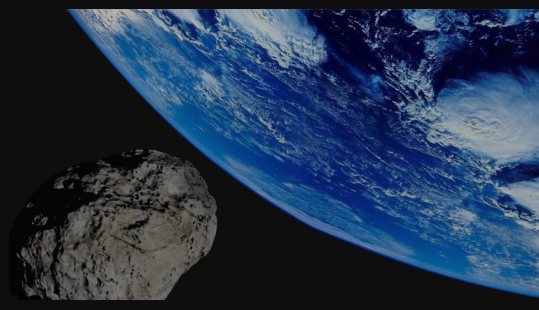
PHILOSOPHY & PSYCHOLOGY

39 PANPSYCHISM
Rayyan wonders if the cosmos is secretly awake.



ORIGINAL RESEARCH

73 NEAR EARTH ASTEROIDS
Sana Salim details the vital radar systems tracking space rocks to shield Earth from danger.

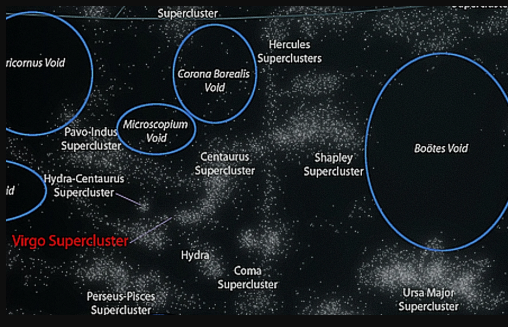


77 DARK, BUT NOT DULL: A JOURNEY INTO DARK MATTER
Dark matter is like an invisible cosmic glue that holds galaxies together; Naima reveals how it structures our universe.

POETRY & ALLEGORY

49 WHAT THE SKY LEFT BEHIND
Eman Yasir explores the deep, endless wonders left behind in the sky.

64 ALL IS NOT LOST
Izza and Zaid join forces, giving the night skies a voice in this masterpiece allegory.



REVIEWS & INTERVIEWS

24 INSIGHTS INTO ICAST
What does the future of space tech look like? Dr. Najam sits down with us to share the big milestones and dreams behind this landmark event.

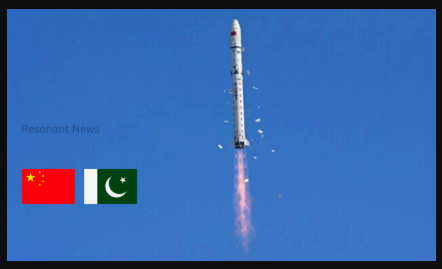
82 BOOK REVIEW: HALO – THE FALL OF REACH
Before the games came the lore: Rayan critically analyzes Eric Nylund's gritty Halo military sci-fi.

84 FILM REVIEW: JAHAN AUR BHI HAIN – BEYOND THE BLUE
When local cinema dares to dream bigger, boundaries expand: a perceptive review evaluating rare alternative realities.

FUTURE OUTLOOKS & CURRENT AFFAIRS

45 MARS MACHINE AND WOMEN
Hafsa Akhtar explores how women are shaping planetary science, from intelligent machines and exploration to the future of human presence beyond Earth.

86 FLOODING THOUGHTS (AFTERWORD)
Penning the brutal reality of the 2025 floods and looking ahead, Mahnoor reflects on ecological trauma matched with our starward gaze.



SPOTLIGHTS & NEWS

89 NEWS UPDATES

91 THE NEW SPACE ERA OF PAKISTAN

95 A GLIMPSE AT THE SOCIETY

ABOUT & INFO

98 Feedback & Submissions

99 References & Credits

OBSESSED WITH *THE MOON*

Insights into Darya Kawa Mirza's Lunar Photography

by SYED ZAIN AAMIR

Darya Kawa Mirza, a self-taught Astrophotographer from Erbil, Iraq, has garnered international attention for his breathtaking images of celestial bodies, particularly the Moon.

Despite holding a Master's degree in Soil Science and working as a government employee, Mirza's passion lies in capturing the beauty of the night sky. His journey into astrophotography began when he shared his first Moon image on his Instagram profile, *@daryavaseum*

The positive engagement he received, especially given the extreme rarity of this hobby in his country, motivated him to delve deeper into the field. To set his work apart, he embarked on creating a Moon mosaic – a high-resolution image entirely composed of numerous smaller sections pieced together like a puzzle.

For Mirza, photographing the Moon is an endless journey of discovery. He never tires of capturing its beauty, stopping only when fatigue sets in. His dedication and unique perspective have not only distinguished his work but also inspired a global audience to appreciate the wonders of the cosmos.

Looking ahead, Mirza plans to expand his astrophotography endeavors to include more high-resolution images of distant planets, galaxies, and nebulae, further sharing the marvels of the universe with the world.

To experience Mirza's work firsthand, you can view his enhanced composite image of the Moon, showcasing surface features like seas and craters, with blue areas indicating higher iron content and orange areas showing more aluminum.

One of his notable projects includes capturing the Blue Moon, an event that occurs once every two to three years. Using a powerful telescope, Sky Watcher 250p Flex tube, paired with an astronomical camera, Mirza achieved stunning clarity and detail in his photographs. This equipment allowed him to capture the faint colors on the Moon's surface: reflections of light bouncing off different minerals, resulting in tones like orange, red, and blue.

In our online discussion, Darya Kawa Mirza said about his work:

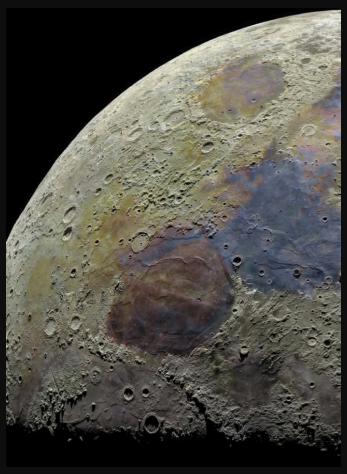
"As for my field I'm an agricultural engineer, exactly... soil pollution.

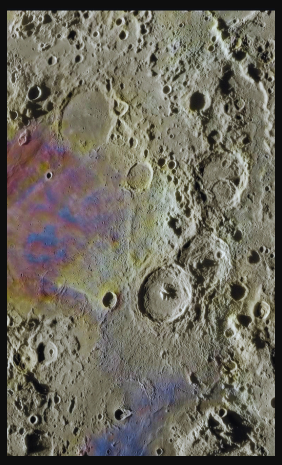
So astrophotography and soil science are far away from each other but I found I could achieve more things if I start doing astrophotography despite living in a light polluted city which is challenging for me and it's very hard to acquire astronomy equipment here. I was lucky to choose this path, the thing is, this is a rare hobby and you could easily draw people's attention to you and all those things made me find happiness and joy.

I know many astronomers who have way more advanced equipment, but they cannot achieve the maximum capability of what their telescopes could do may be due to bad geological location. As for me, I was a landscape photographer before I entered this field, so I know how to properly edit astrophotography images, unlike many others who started their zero-mile journey straight from fundamental astrophotography.

Knowing how to edit your image makes a whole lot of difference."

LUNAR ECLIPSE of 7th, September 2025

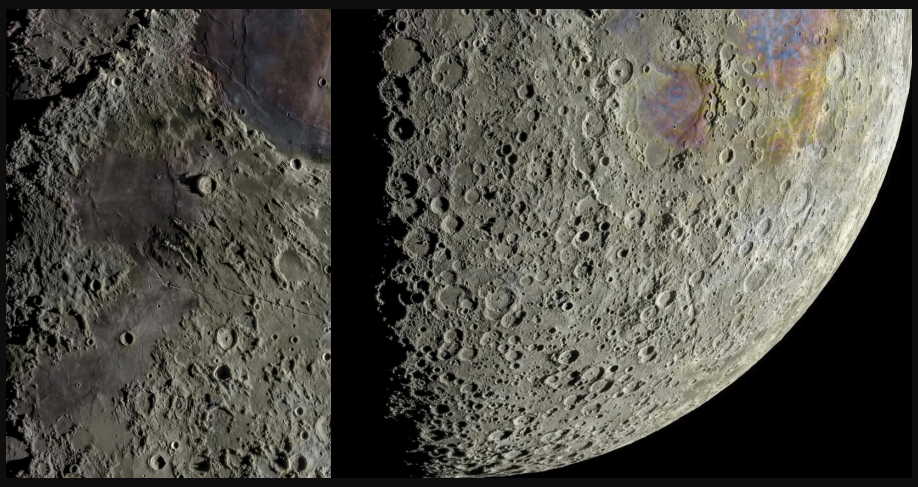




NASA recognized Darya Kawa Mirza's astrophotography talent by featuring his enhanced image of the Moon in its **Astronomy Picture of the Day** (APOD) on January 16, 2023, showcasing the Moon's rich textures and geological details. It is one of his lunar images, selected for being the clearest and sharpest moon image, which took him 4 days of continuous moon observation.

"This is what the moon looks like if it was a flat disk with mountains on it"

says Darya

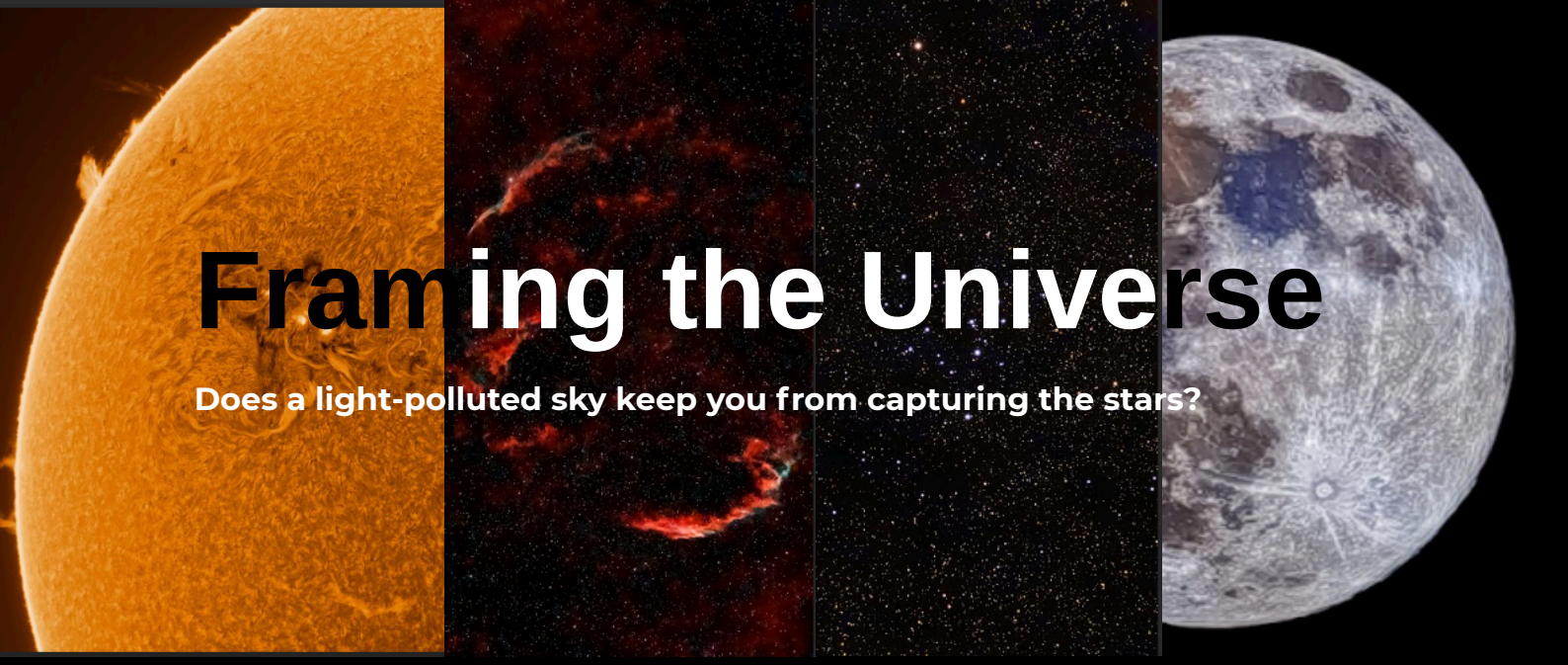


- 708GB file size
- 81,000+ images stacked
- 4 moon phases merged
- Telescope: Skywatcher Flextube 250p on NEQ6 pro
- Cameras: Canon 1200D (minerals), ZWO ASI 178mc (details)
- No AI used
- 159.7 megapixels

▼ Image Credit: All lunar photos are by Darya Kawa Mirza (@daryavaseum) and used with permission.

Syed Zain Aamir

From the Space Science department at The Institute of Space Technology, hailing from SS-13, Zain has always been interested in space-related fields, which is why he continues to explore the cosmos with curiosity and enthusiasm. He is enjoys working and conducting research in areas connected to space and its many mysteries.



Framing the Universe

Does a light-polluted sky keep you from capturing the stars?

Astrophotography is all about passion, patience, and perseverance. Whether you spend two hours capturing the Milky Way or an entire night integrating data from a distant nebula, these qualities push the boundaries of what amateur astrophotography can achieve. Roshaan Nadeem, a Space Science graduate from Institute of Space Technology based in Lahore, possesses them in abundance. His work began with the Moon and planets, then expanded to deep-sky objects like Orion and the Sadr region—along with the wonders of the Sun itself. Beyond the images, he shares the science behind each frame with Pakistan's astronomy community, and his work is now used in school and college outreach. In this article, we speak with Roshaan about his journey and the stories behind his images.

1. What first sparked your interest in astrophotography and do you remember the moment you decided to pick up a camera to shoot the night sky?

My interest in astrophotography was totally inadvertent. I had no initial plan to do astrophotography when I got my first telescope; I just wanted to observe the Moon and the planets of our solar system. However, once I started observing through my telescope, I began taking pictures through it with my phone, as I wanted to share those views with my family and friends.

Every day I tried to take better pictures than the day before, and ultimately, I realized that I have started doing astrophotography, which is a whole field in itself.

2. Was there a particular image, event, or figure in astronomy that inspired you to pursue this path?

The people of Lahore Astronomical Society (LAST) were my inspiration. I used to see their photography online and was always amazed. I am really thankful to them as they helped me develop my skills of astrophotography by giving continuous support and feedback.

Image: Lahore Astronomical Society

3. Can you walk us through your typical astrophotography workflow from planning a shoot to processing the final image?

Firstly, you have to decide the object(s) you want to photograph on a particular night and plan the night accordingly. Different objects are visible at different times so planning is crucial. Then you have to set up the telescope and camera, align your mount with the stars, and then begin acquiring data. That data is then processed in different software to boost the signal-to-noise ratio, and finally, the final image comes out.

4. You talk about insignificance, how will you define it based on what you have observed so far. How has it changed you perspective about the world and even yourself?

> ***I have photographed so many distant objects in the universe that it makes me realize how insignificant we are***

in terms of our size. The universe is so vast and endlessly expanding and we are just a tiny speck in it. It makes me think about the wars that happen on our planet and how people are killed in the name of power. If we look at earth from space, it looks nothing more than a tiny dot and that dot is significant in the sense that it is the only place in the universe known so far to harbor life. I am an even tiny being on this 'dot' that we see from space and I share it with billions of other tiny beings. The vastness of the universe and our place in it calls us to preserve and cherish the blue dot on which we all live.

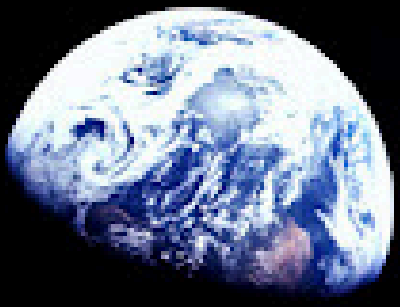
5. Have you collaborated with astronomers, researchers, or other creatives? How do you think science and art come together in astrophotography?

Yes indeed I have collaborated with many astronomers and we have worked on many different space related projects. As for how I think science and art can come together in astrophotography? Astrophotography is not just about taking pretty pictures. There's a lot of science going on in most of the beautiful artistic pictures you see online. It's all about perspective.

6. What's your favorite piece of gear or software and why? Is there anything in your kit that might surprise people?

Image: AstroBackyard

Recently, I bought a smart telescope ZWO Seestar S30. It's special because it is fully automated and makes deep space astrophotography very fun and convenient.



7. If you could shoot from anywhere in the world or off it, where would it be and what would you hope to capture?

Probably from the Polar regions, high latitude areas. Maybe even Antarctica!

I would really like to see the Auroras.

Photo via Unsplash

Andromeda Galaxy | M31

Two and a half million light-years away, our nearest spiral neighbor drifts toward us—a trillion stars locked in a slow collision course with the Milky Way. From Bortle 8 skies in Lahore, one of the most light-polluted cities on Earth, it looks like a faint smudge. But look closer: that smudge is coming right at us.

Equipment & Location

Bortle 8 skies, Lahore, Pakistan.
ZWO Seestar S30.
2 hours 20 minutes integration.

8. Your journey as an astrophotographer has taken you to international stages like IAC Baku, Milan, a TED Talk, and beyond; do you think it's solely your photography that led you there, or are there other passions within astronomy and science communication that helped shape this path?

No it hasn't been just my astrophotography. I am involved in astronomy in various ways. Astrophotography is just one of them. I am also a space/astronomy communicator, General Secretary of Lahore Astronomical Society where we try increase Astronomical Awareness in Pakistan. My participation in the International Astronautical Congress (IAC) and the Space Generation Congress (SGC) last year was to present my research work which was on a variety of topics: From terrestrial microgravity platforms to space traffic management.

9. What kind of stories do you hope your images tell, especially to younger audiences or people who've never seen a dark sky?

Something that they have never seen or thought they could never see from a place like Pakistan, with amateur equipment.

10. What advice or message would you give to young aspiring astrophotographers especially those starting out in light-polluted cities like Lahore?

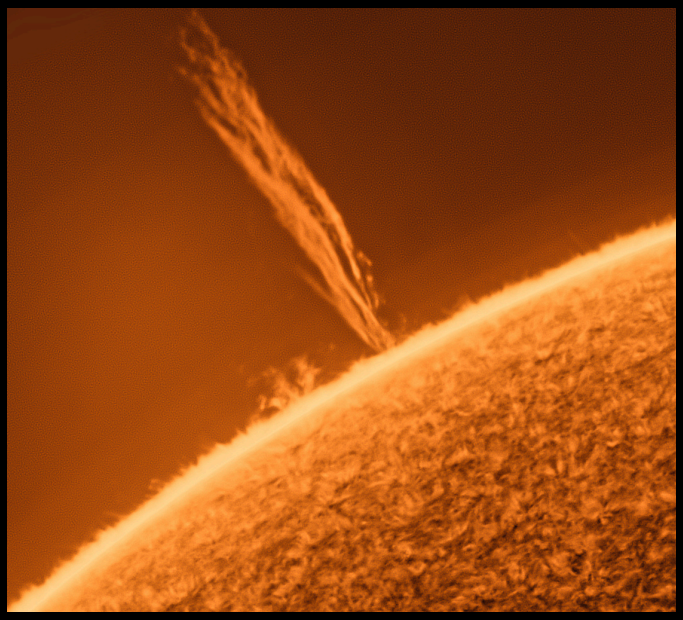
Be patient. Astrophotography is very frustrating sometimes especially from light polluted cities like Lahore. You will not get the best results right away. Everyone has to go through the learning curve. There are no shortcuts to your dream image.

Roshaan Nadeem was Director of Observational Astronomy for the Space Society at IST.

Space Galllery

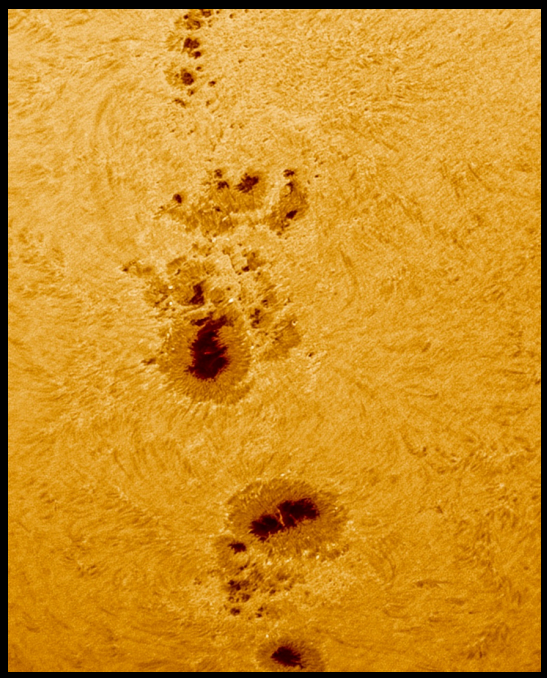
Solar Flares

A flame-like prominence on the Sun. This is sun's plasma surging outwards in the solar chromosphere, due to the presence of strong magnetic fields. An H-alpha view of the sun's surface, captured mid-burst.



Sunspots

A group of sunspots – regions on the Sun where temperature is relatively less and the magnetic field is strong. Even the smaller ones are bigger in size than Earth. The hydrogen-alpha lens, revealing the dark patches that are the Sun's hidden turmoil.



The Pyramid Cluster (M39) | A Star-Lit Gateway

Floating 800 light-years away in the constellation Cygnus, this open cluster is a quiet gathering of brilliant suns. Known as the Pyramid Cluster for its distinct triangular shape, it hangs like a bright, descending marker in a crowded "tunnel" of our galaxy. Because the stars are so spread out, the ink-black depth of the Milky Way bleeds through the gaps, giving us a rare, three-dimensional look into the vast space between the stars.

The Pleiades (M45) | The Celestial Neighbors

Just 440 light-years away, these "Seven Sisters" are practically our next-door neighbors in the cosmic suburb. While the technical reality is an open cluster of hot, B-type stars, the visual is more like a handful of blue diamonds scattered across a velvet cloth. The faint, ghostly glow around them is a reflection nebula—ancient starlight bouncing off a passing cloud of dust, creating a shimmering veil that feels both cold and incredibly vibrant.

The Cygnus Loop | Circle of Memory

At 2,400 light-years away, these delicate filaments are all that remains of a star that exploded 20,000 years ago. In reality, this supernova remnant is a giant bubble forming a three-degree wide circle across our night sky—spanning six times wider than the full moon. The star itself is gone, but its explosion blasts materials into space to build new stars and planets.

The Orion Nebula (M42) | The Bright One of the Sword

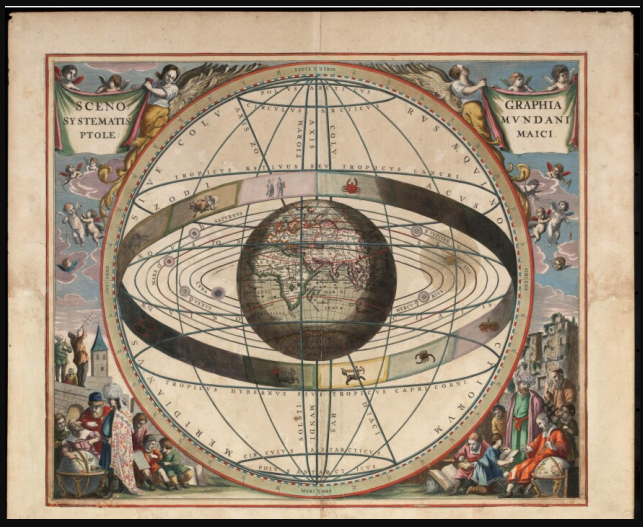
At 1,350 light-years away, this famous cosmic furnace hangs just below Orion's three belt stars on winter nights, lighting up the giant's sword like a bright jewel. What you're seeing is a crucible of creation—a swirling cloud of dust and gas where gravity is busy condensing materials into a myriad of new suns. To look at this nebula is to confront the raw genesis of a solar system, the exact process that formed our own Sun.

IC 1318 – Sadr Region

At 5,000 light-years distance, the Sadr Region is the true "deep" in deep-space photography. This massive complex of glowing gas ”the Butterfly Nebula” lies behind thick lanes of galactic dust. When you look at this image, you are peering through one of our galaxy's most crowded neighborhoods. The light captured began its journey when human civilization was just beginning to write—a vast wall of energy that makes our solar system feel like a single grain of sand on an infinite beach.

Captured from Bortle 8 skies , 2 hours and 30 minutes of integration with a ZWO S30 smart telescope. From Pakistan, reaching 5,000 years back in time.

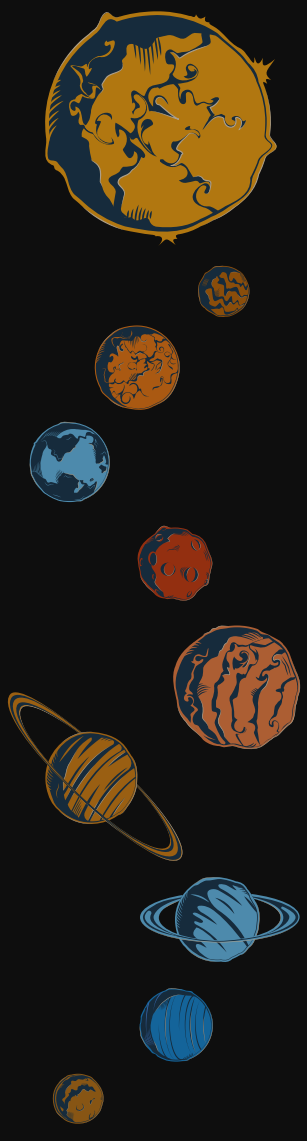
THE ANCIENT INTERPRETATIONS AND UNDERSTANDINGS OF THE COSMOS



by RAYYAN SAGHEER

Where gods, numbers, and the night sky converged

Long before telescopes or satellites, people looked up and saw gods written in the stars. For the Mesopotamians, Egyptians, and Babylonians, the heavens were alive with divine powers whose movements touched every part of human life. Stars and planets weren't seen as distant objects but as gods themselves: Inanna shining as Venus, Ra reborn in the Sun, or Sirius heralding the Nile's flood. Careful observation of these bodies gave rise to calendars, agricultural planning, and divination, tying religion, kingship, and cosmic order together. Over time, these traditions evolved into systematic records, eventually forming the backbone of Babylonian astronomy, which could even predict eclipses and planetary cycles. This knowledge later inspired Greek and Roman thought.

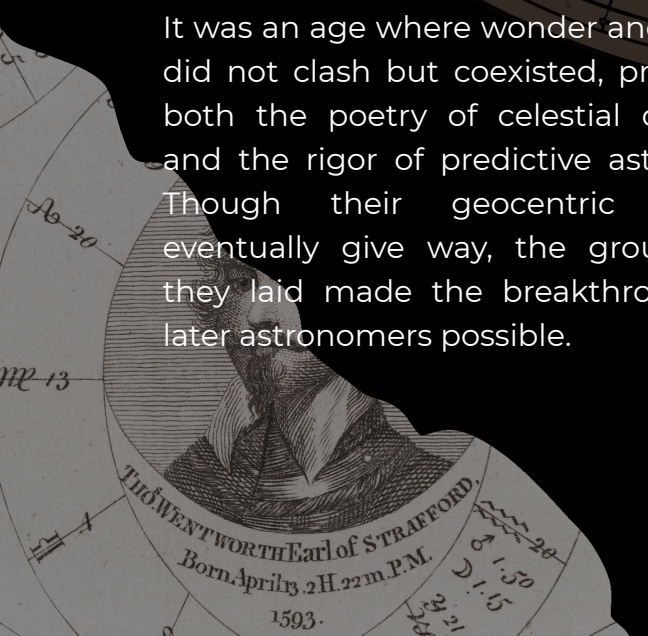


In the Hellenistic world, a profound shift took place. Greek philosophers began to search for rational explanations of the heavens, blending geometry with observation. Thinkers like Pythagoras, Plato, and Aristotle imagined a geocentric universe, with Earth at its center and the heavens revolving in ordered harmony.

By the 2nd century CE, Claudius Ptolemy in Roman Alexandria had refined this into a work known as The Almagest, a mathematical framework that explained planetary motions through systems of epicycles. This geocentric model was accurate enough to guide astronomical predictions for more than a thousand years, despite the fact that it was imperfect. Yet, even as science advanced, the theological aspect of the cosmos, which was developed through millennia of theological fervour, remained strong: the planets kept the names and qualities of the gods, their motions still read as signs of divine will, albeit in a more symbolic sense.

For the Romans, this marriage of science and theology was especially vivid. Jupiter, Venus, and Mars were not just planets but works, contributed to astronomical observation with reflections on fate and morality. In Rome, natural philosophy and religion were not separate but they were two voices describing the same cosmic truth. This blending of myth and measurement gave the Greco-Roman world a cosmology like no other: one where gods animated the planets and yet their paths could be traced with remarkable mathematical precision.

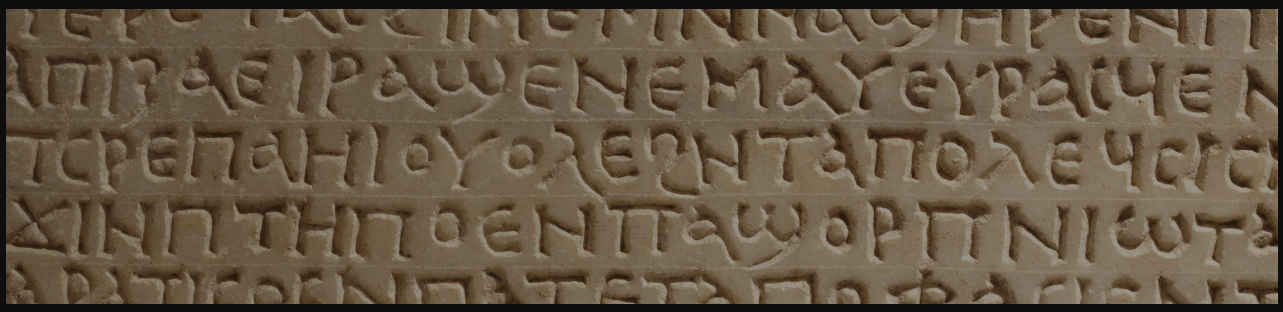
It was an age where wonder and reason did not clash but coexisted, producing both the poetry of celestial divinities and the rigor of predictive astronomy. Though their geocentric models eventually give way, the groundwork they laid made the breakthroughs of later astronomers possible.



During the medieval period, scholars from the Arab and Persian worlds carried forward the legacy of ancient astronomy, blending observation,the living manifestations of their divine namesakes. To look at the night sky was, in a sense, to watch the gods themselves moving across the heavens. Astrology, adopted from early Mesopotamia and then reshaped in the Greco-Roman world, became a cultural force as emperors and generals consulted the stars before wars and political gambles. The Julian calendar, introduced by Julius Caesar in 46 BCE, was designed to align the Roman year with the solar cycle. He consulted the Egyptian astronomer Sosigenes of Alexandria, who recommended a 365-day year with a leap day every four years.

This reform not only synchronized timekeeping with the Sun but laid the foundation for the calendar system, which is still in use today. Meanwhile, writers like Cicero, Seneca, and Pliny the Elder, with their mathematics, and philosophy to deepen humanity's understanding of the cosmos.

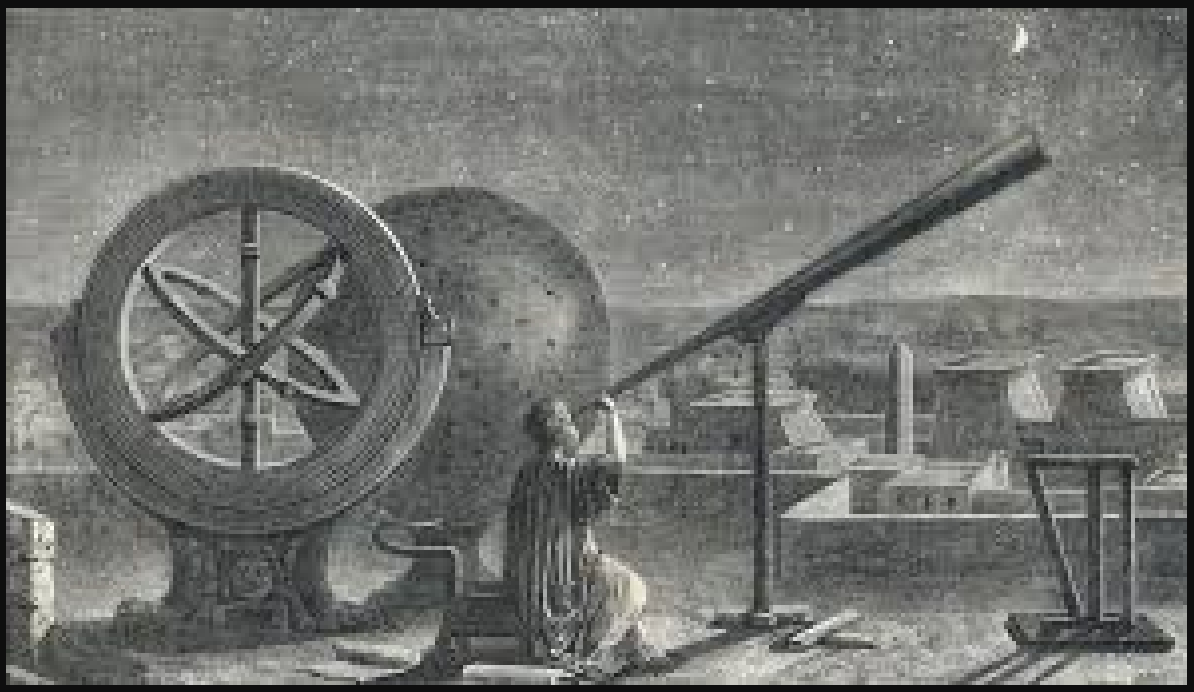
Figures such as Al-Sufi, who catalogued stars and described the Andromeda Galaxy in the Book of Fixed Stars, and Al-Battani, who refined measurements of the solar year and planetary motions, brought remarkable precision to celestial observation. Persian polymaths like Omar Khayyam improved calendar accuracy and explored the Earth's orbit, while Arab astronomers built sophisticated observatories and detailed star charts. Their work not only preserved and expanded on Greco-Roman and Indian knowledge but also shaped the framework through which later European astronomers would study the heavens.



When German mathematician Johannes Kepler famously formulated his three definitive laws of planetary motion in the 17th century, describing orbits with mathematical clarity, he fulfilled a cosmic legacy first chartered under Roman skies.

Today, as spacecraft map exoplanets and telescopes peer into galaxies billions of galaxies billions of light-years away, we are continuing that same story, transforming the gods of the ancients into the physics of the universe, without

ever losing the sense of wonder that first drew humanity to seek the sky.



Rayyan Sagheer

A Bachelor of Science candidate in Aerospace Engineering at IST; Rayyan's research interests include high-speed aerodynamics, aeroelasticity, and the aero-structural dynamics of fighter aircraft in transonic and supersonic regimes. He is also keenly interested in space systems and orbital mechanics.

International Conference on Applications of Space Science & Technology (ICAST) at the Institute of Space Technology

Prof. Dr. Najam Abbas Naqvi is an accomplished academic leader and project strategist with 25 years of experience in higher education, research, and national-level program management in space science and technology. He currently serves as Chairman of the National Center of GIS and Space Applications (NCGSA) and Professor at the Institute of Space Technology, Islamabad, Pakistan. His leadership encompasses academic management and multi-institutional capacity-building initiatives. He has curated and contributed to numerous conferences, seminars, and policy forums. His core interests include GNSS, satellite systems, institutional development, space education, and space project management.

What core vision drove the creation of ICAST at IST, and what critical gaps in Pakistan's space tech ecosystem does it address?

The core vision behind ICAST was to establish an international platform that brings together subject-matter experts, academicians, researchers, students, and industry professionals under one roof to explore the theme “Space for Sustainable Development.”

The conference was conceived to address a critical gap in Pakistan’s space and technology eco-system by fostering meaningful industry–academia collaboration and integrating national expertise with global international best practices.

ICAST represented a deliberate effort to strengthen Pakistan’s space ecosystem by connecting all key stakeholders, policy, academia, research, and industry within a single, structured forum. It was a first-of-its-kind initiative in Pakistan, where the National Space Agency (SUPARCO) and the country’s leading space university (IST) had collaborated to promote more sustainable space-enabled socio-economic development while positioning IST as a national and regional hub for space-led innovation and capacity building.

Why choose a three-day, multi-track format for ICAST, and what are its key advantages over single-focus events?

The decision to adopt a large, multi-track format was deliberate and rooted in the inherently interdisciplinary nature of modern space science and technology. Plenary sessions, seminars, forums, panel discussions, parallel technical tracks, master classes, and exhibitions were designed to ensure that diverse audiences, students, researchers, industry professionals, and policymakers, could all find relevance and value within a single event. Compared to other single-track conferences, this structure enabled greater cross-pollination of ideas, broader intellectual exposure, and the creation of a vibrant, integrated ecosystem rather than isolated technical sessions.

ICAST was designed to offer learning opportunities for participants at all levels. By providing a strong networking platform, it drives multidisciplinary dialogue, collaborative research, and actionable outcomes within a cohesive framework. In essence, ICAST was structured to achieve multiple objectives i.e. learning, networking, and collaboration within a cohesive framework.

How does ICAST balance technical depth and broad exposure for students across academic levels?

Short-duration conferences like ICAST cannot replace in-depth technical training, classroom learning, or sustained research; however, they are highly effective for providing strategic exposure. For undergraduate students, such platforms spark curiosity and create awareness of emerging technologies and career pathways. For graduate students and early-career researchers, they offer critical context, direction, and opportunities for professional networking.

The key lies in maintaining a balance, combining focused technical sessions with broader discussions on applications, policy, and career development. This approach helps participants appreciate both the depth and the evolving flow of technology, while clearly illustrating how academic concepts translate into practical research, real-world applications, and national development objectives.

What long-term academic, professional, or institutional connections do you expect ICAST to generate?

ICAST is expected to serve as a catalyst for long-term academic, professional, and institutional collaborations across universities, research centers, and industry. This spans both national and international scales. These outcomes include joint research initiatives, student and faculty exchanges, co-supervision of graduate research, and the development of institutional MoUs that extend well beyond the conference itself.

Equally important are the informal networks formed among peers, mentors, and practitioners, which often play a defining role in shaping academic and professional careers over time. The participation of international astronauts, representatives from space agencies, and organizations such as ISNET, APSCO, ICESCO, BRAIA, and IEEE significantly strengthens the potential for sustained collaboration, mutual research, and shared academic programs. At the national level, engagement between academia and industry is expected to accelerate space-enabled solutions for socio-economic development, further strengthening and enriching Pakistan's space ecosystem.

Students played key management roles in ICAST. What do they gain most from organizing it, and how can future editions deepen these benefits?

The involvement of students as part of the Conference Student Management Team was one of the most rewarding aspects of ICAST. Their participation provided hands-on experience in leadership, teamwork, communication, and problem-solving—skills that are rarely developed through classroom instruction alone. Academically, students gained confidence through direct interaction with national and international experts, as well as by presenting and discussing their work in a professional setting.

From a professional perspective, students developed practical competencies in large-scale event management, including scheduling, resource allocation, hospitality, publications, protocol, and stakeholder coordination. These experiences also enabled them to build valuable professional networks. Looking ahead, such gains can be further strengthened through structured mentorship, credit-based academic recognition, and post-conference reflection or follow-up projects. The learning acquired through this experience is long lasting and is likely to benefit students throughout their academic and professional careers.

Looking back, what key lessons did ICAST offer for organizing future space and technology conferences in Pakistan?

One of the key lessons from organizing ICAST is the critical importance of detailed planning guided by clear objectives, effective use of technology, and the involvement of multiple stakeholders via well-defined communication channels.

Strong coordination between academic programming, logistics, and student management teams proved essential to the smooth execution of such a large-scale event. Future conferences can further benefit from more focused and structured industry integration, and clearly defined follow-up mechanisms. These steps will help translate conference discussions into actionable outcomes, sustained collaborations, and measurable long-term impact.

With significant resources and planning behind it, What lasting connections do you expect will shape ICAST's long-term success?

The success of a large international conference like ICAST should be assessed at two complementary levels. During the event, success can be measured by how closely the outcomes align with the original objectives, along with the quality of sessions, diversity of participation, level of student engagement, effectiveness of media outreach, international representation, stakeholder involvement, and the depth of intellectual exchange.

After the conference, success is better reflected through tangible as well as sustained outcomes such as initiated collaborations, publications, funded research projects, internships, and continued community engagement. Ultimately, long-term impact and continuity of outcomes rather than attendance figures alone serve as the most meaningful indicators of a conference's true value.

Would you like to share a message with students, researchers, and space enthusiasts who could not attend ICAST? How can they continue to engage with the momentum it created?

To those who could not attend ICAST, the momentum created by the conference does not end with the event itself.
Space science and technology thrive on continuous learning, collaboration, and sustained engagement. Pakistan's space community is steadily growing, and there is both room and a genuine need for every motivated student, researcher, and enthusiast to contribute.

Space is for all, and space-based technologies offer solutions to challenges across multiple sectors, directly supporting socio-economic development.

The message is simple:

> Continue to learn, explore, apply your knowledge, and actively engage with the space ecosystem because meaningful progress in space begins with informed and committed participation.

We Are All Made of Stardust: *The Cosmic Story of Life and Death*

by AREEBA AZIZ

Look for: The Ring Nebula is a stunning example of this final phase, a cosmic bubble blown by a dying star.

Source: James Webb Space Telescope

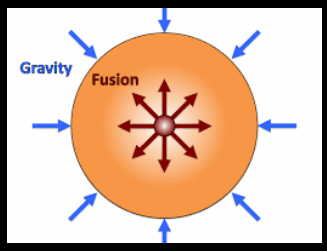
Look at your hand. What do you see? Skin, perhaps a ring, the trace of veins underneath. Now, consider this: the calcium in your bones, the iron in your blood, and the gold in your jewellery were not born on Earth. They were forged in the heart of a star that died a spectacular death billions of years ago. We are not just living in the universe; the universe is living in us.

WE ARE, IN THE MOST LITERAL SENSE, MADE OF STARDUST.

This connection between our bodies and the cosmos is one of the most beautiful and profound ideas in science. It all starts with the dramatic end of a star's life.

The Great Cosmic Balancing Act:

A star's life is a constant battle between two powerful forces. On one side is gravity, which tries to crush the star inward. Pushing back is the tremendous energy from nuclear fusion, the process of atoms merging at the star's core. For millions or even billions of years, these forces are perfectly balanced. But when a star runs out of nuclear fuel, this balance shatters, and its fate is sealed by its size.



Source: Stanford University

A Star's Final Act: Three Different Endings

Not all stars die the same way. Their mass determines whether they get a quiet retirement or go out in a blaze of glory.

The Peaceful Fade: For Stars Like Our Sun

Stars like our Sun experience a relatively gentle end. In its old age, our Sun will swell into a Red Giant, eventually shedding its outer layers into space. These layers will form a beautiful, glowing cloud of gas called a planetary nebula. All that will remain is the star's hot core, now called a white dwarf, a dense Earth-sized ember that will slowly cool for eons.

The Supernova: The Universe's Biggest Fireworks

For stars much more massive than our Sun, death is swift and violent. When they run out of fuel, their core collapses in less than a second and then rebounds in a cataclysmic explosion called a supernova. For a brief moment, a single supernova can outshine its entire galaxy.

This incredible blast is a cosmic element factory. The immense heat and pressure create new, heavier elements like the oxygen we breathe, the silicon in rocks, and the iron in our blood and then scatter them across the galaxy.

Look for: The Cassiopeia. A supernova remnant shows the beautiful, expanding debris from such an explosion.

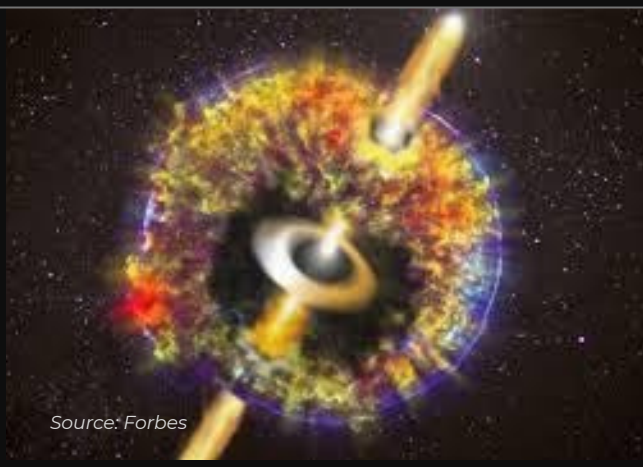
Source: Chandra X ray Observatory

The Leftovers: Extreme Remnants

The supernova blasts the star's material into space, but the core remains, collapsing into one of two incredible objects:

A Neutron Star: A city-sized ball of matter so dense that a single sugar cube-sized amount would weigh as much as a mountain.

A Black Hole: If the core is massive enough, its gravity becomes so strong that not even light can escape, creating a black hole.



Source: Forbes

The Bonus Round: Forging Gold in a Cosmic Crash

The very heaviest elements, like gold, silver, and platinum, are created in an even more exotic event: the collision of two neutron stars. This event, called a kilonova, is the universe's ultimate goldsmith. In 2017, scientists detected such a collision and confirmed it created a huge amount of gold and other precious elements.

Source: NASA

The Circle of Life: *From Death Comes New Birth*

This stellar death is not an end. It is a vital act of cosmic recycling. The new elements forged in these explosions are flung into space, mixing with gas and dust. This enriched material collapses to form new stars, planets, and moons. Our entire solar system, consisting of the Sun, Earth, and everything on it, was made from the recycled remains of these long-dead stars. The water in our oceans, the ground beneath our feet, and the very cells in our bodies are all composed of this stardust.

The proof? Scientists have found tiny grains of actual stardust inside ancient meteorites. These specks, called pre-solar grains, are older than our Sun itself.

So, the next time you gaze up at the night sky, remember that you are connected to it. The death of ancient stars was a necessary chapter in the story of your life. We are the universe's way of looking back at itself, a collection of atoms that slowly learned to think, wonder, and explore our own cosmic origins.

Areeba Aziz

A BS Space Science student at IST interested in astronomy and astrophysics, passionate about studying celestial phenomena from stellar evolution and galactic dynamics to orbital mechanics and cosmological models, with the ambition to investigate the physical laws of the universe and immerse herself in the scientific pursuit of understanding its hidden complexities.

Active Retry Control System (ARCS) for Reliable Solar Panel Deployment in CubeSats

by IMAMA FATIMA

Introduction

The idea for the Active Retry Control System (ARCS) came from a simple but troubling observation. Most CubeSat missions rely on a one-time solar panel deployment mechanism. Once released, the system does not have a chance to reset. This vulnerability means that even a small failure can threaten an entire mission, wasting months of work and valuable orbital time.

This concern led to the question: what if there was a way to give these systems a "retry," allowing them to fix themselves if the first attempt failed? That query developed into the ARCS concept, a lightweight system that uses feedback to detect deployment issues and make necessary adjustments on its own.

Designed for a 3U CubeSat, ARCS adds active control to an otherwise passive satellite. It employs feedback logic and compact actuators like Shape Memory Alloy (SMA) wires or magnetic pulse systems. ARCS identifies when a panel does not deploy fully and responds by activating small corrective impulses to complete the deployment—all aims not only to improve mission resilience but also to embrace a simple engineering philosophy. Reliability comes from smart system logic instead of heavy redundancy or extensive testing.

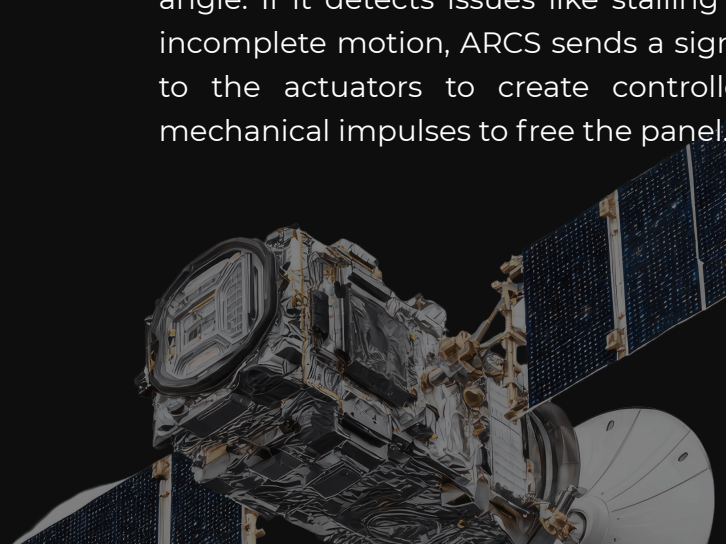
System Concept

The ARCS works within a 3U CubeSat platform that remains entirely passive otherwise. The system has an onboard feedback mechanism that constantly checks the solar panel's deployment angle. If it detects issues like stalling or incomplete motion, ARCS sends a signal to the actuators to create controlled mechanical impulses to free the panel.

Possible methods for actuation include:

- **Shape Memory Alloy (SMA)** these wires, when activated with electricity can produce repeatable contractions.
- **Magnetic pulse actuators**, which deliver short bursts of force without direct contact.

The control logic guarantees that actuators work only in brief, controlled intervals. This helps prevent excessive force from damaging the CubeSat structure or solar panels.



Key Technical Considerations

1. Force Calibration

- The strength of corrective impulses must be fine-tuned.
- Excessive force can damage the panels or CubeSat bus.
- Insufficient force may lead to repeated mission failure due to ineffective corrections.
- Iterative ground testing and simulations are necessary to find safe and effective impulse levels.

2. Weight Constraints

- CubeSats must follow strict mass limits, especially in a 3U configuration.
- ARCS aims to reduce added hardware by incorporating sensors and actuators into the hinge housing.
- Target weight increase: less than 2–3% of total CubeSat mass, ensuring adherence to standard payload limitations.

3. Energy Consumption

- Actuation components, particularly SMA wires, need power surges to activate.
- Duty cycles and pulse intervals must be optimized to prevent draining the CubeSat's limited power budget.

4. Reliability of Control Logic

- Closed-loop monitoring makes sure deployment angles are confirmed at each step.
- Backup actuation attempts are activated if the initial pulses do not work, which increases mission survivability.

Expected Outcomes

By introducing ARCS, CubeSats gain a second chance at solar panel deployment instead of depending on a one-time passive mechanism. The modular design allows for adaptability across different CubeSat platforms and missions without major redesigns.

Initial modeling indicates that ARCS can significantly improve mission reliability by providing an active corrective system. However, since no physical testing has been conducted yet, these estimates remain within a reduced-engineering framework, focusing on conceptual validation and feasibility analysis rather than total readiness for deployment.

Conclusion

Passive solar panel deployment systems create a single point of failure for CubeSat missions. The ARCS concept offers a practical and lightweight solution that combines sensing, control, and corrective actuation. By actively tackling deployment issues, ARCS presents a substantial boost to mission survivability, supporting more resilient and sustainable satellite operations.

Imama Fatima

An undergraduate aerospace engineering student at the Institute of Space Technology, Pakistan, she has developing interests in small-satellite mechanisms, structural modeling, and analytically driven design for space systems. As part of Team Clover, she worked with Rumman Yousaf Abbasi and Syed Hassan Raza Bukhari on the ISSSP 2025 project, contributing to conceptual development, numerical analysis, and system documentation for the proposed in-space solar panel realignment mechanism.

Orbital Dominance or Space Wars: The Evolution of Satellite Warfare

by SYED ZAIN AAMIR

Eyes in the Sky: The Role of Satellite Technology in Modern Warfare

While space has been an excellent forum for peaceful exploration, it is also an excellent high ground from which to gain military advantage. Spy satellites have been in use for decades. In the 21st century, the battlefield is no longer confined to trenches or terrains; it has extended far beyond Earth's surface into the vast expanse of space. Among the most transformative advancements in military strategy is the integration of satellite technology, which has redefined the nature of modern warfare. These orbiting assets, once considered tools for weather forecasting and communication, are now key players in national defense, surveillance, intelligence gathering, precision attacks, and even controversial weather modification and orbital weapons systems. This is course of evolution of modern Satellite warfare.

During the Cold War, the United States and the Soviet Union launched the first military satellites, primarily for spy missions and early warning systems. Today, countries around the world rely on an intricate web of satellites for purposes ranging from reconnaissance to electronic warfare.

But the question is:

Where are they used?

Surveillance and Reconnaissance

High-resolution imaging satellites monitor enemy movements, military installations, and strategic assets across continents. Using synthetic aperture radar (SAR) technology, these satellites can capture images day or night and through cloud cover too.

Real-time footage and heat signatures can be used to assess threats or to confirm the effectiveness of military operations.

Navigation and Targeting

The Global Positioning System (GPS), initially developed by the U.S. Department of Defense, is a satellite-based navigation tool that allows for precision-guided missiles and smart bombs. Military GPS is more accurate and resistant to jamming than its civilian counterpart, allowing for attacks with pinpoint accuracy while minimizing collateral damage.

Early Warning and Missile Defense

Infrared surveillance satellites detect the heat signatures of ballistic missile launches almost instantly, giving nations early warning to deploy missile defense systems. These satellites form the first line of defense in anti-ballistic missile networks, which are crucial for national security in regions with hostile neighbors.

As technology continues to advance, satellites are being engineered as direct weapons to unleash direct destruction on enemy grounds. These space weapons include weapons that can attack space systems in orbit.

- **Space-to-Earth weapons**
  The Orbital weaponry

Nazi Germany space weapon project.

Orbital weaponry is defined as any weapon that is in orbit around a large body such as a planet or moon. There are no known operative orbital weapons systems, but several nations have deployed orbital surveillance networks to observe other nations or armed forces.

- **Earth-to-space weapons**
  Anti-Satellite (ASAT) weapons

Anti-satellite weapons, which are primarily surface-to-space and air-to-space missiles. RIM-161 Standard Missile 3 anti-ballistic missile can engage targets in low Earth orbits.

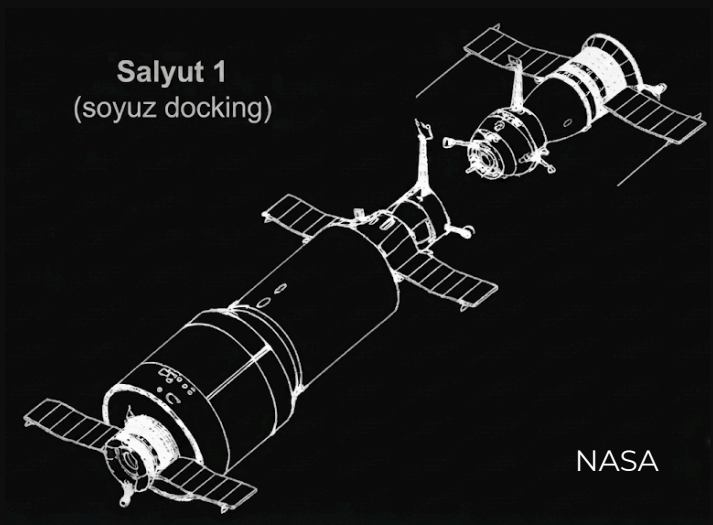
Space weapons are also a central theme in military science fiction and sci-fi video games. But the struggles to militarize the space goes on by many Nations on earth to asset dominance in the orbital space, USA, China and Russia are currently advanced in satellite modern warfare

- **Weaponized Satellites**

With so many satellites orbiting the Earth, how difficult would it be to outfit one with a weapon ready to fire at the Earth, or other satellites, as circumstances dictated? While such a concept violates agreements such as **the Outer Space Treaty (OST),** which bans weapons of mass destruction in orbit, a few military organizations have discussed it in recent years.

- **Soviet Union's Almaz Space Station**

The Almaz space station was conceived in the 1960s as a strategic platform, designed to make it easier for the Soviet Union to search for sea-based targets, according to Russian space expert Anatoly Zak, who runs the website RussianSpaceWeb.com.
It was believed that having humans in orbit would provide a powerful platform for orbital reconnaissance and allow the rapid changing of targets as battles evolved.



The Soviet Union focused on the race to the moon in the 1960s, delaying the first deployment of Almaz until 1973. It was announced to the world as Salyut-2, the second Salyut space station, so as not to make others aware the Soviets had two space station projects, let alone a military one, Zak wrote.

A failure in Salyut-2 prevented a crew from visiting, but the subsequent Almaz space stations Salyut-3 and Salyut-5 did have crews on board (Salyut-4 was never sent to orbit). The cosmonauts are reported to have performed surveillance on at least one mission, and to have fired a cannon in 1975, but technical problems with the stations prevented most missions from running for their scheduled lengths.

Soviet Almaz (OPS) space station module during assembly at Baikonur (c. 1974).
Images: NASA, Roscosmos, and open space archives.

Manipulating an Asteroid

Military strategists know that space warfare extends far beyond satellites because it includes the ultimate threat of manipulating orbiting asteroids into guided weapons. Scientists know that asteroids are the ultimate killers. After all, a 6-mile-wide (10 km) space rock is believed to have wiped out the dinosaurs roughly 66 million years ago.

Audiences have seen the potential human impacts in movies such as "Meteor"(1979), "Deep Impact"(1998), and "Armageddon"(1998). And even relatively small asteroids can have a big impact, thanks to the tremendous speeds at which space objects travel.

For example, scientists think the object that exploded over the Russian city of Chelyabinsk in February 2013, generating a shock wave that shattered thousands of windows and wounded 1,200 people (as a result of the flying glass shards), was just 66 feet (20 meters) wide.

Space Weapons: Lasers and Sun Guns

Among the most talked-about innovations are orbital lasers and the theoretical sun gun both capable of delivering devastating strikes from space. Orbital Lasers or Laser satellites officially known as directed energy weapons (DEWs), are designed to deliver concentrated beams of energy to disable enemy satellites, missiles, drones, or ground targets.

These systems offer several advantages:

- Speed-of-light delivery: The laser reaches its target almost instantly.
- Stealth: A laser strike can be silent and leave minimal traces.
- No need for ammunition: As long as the satellite has power, it can fire multiple times.

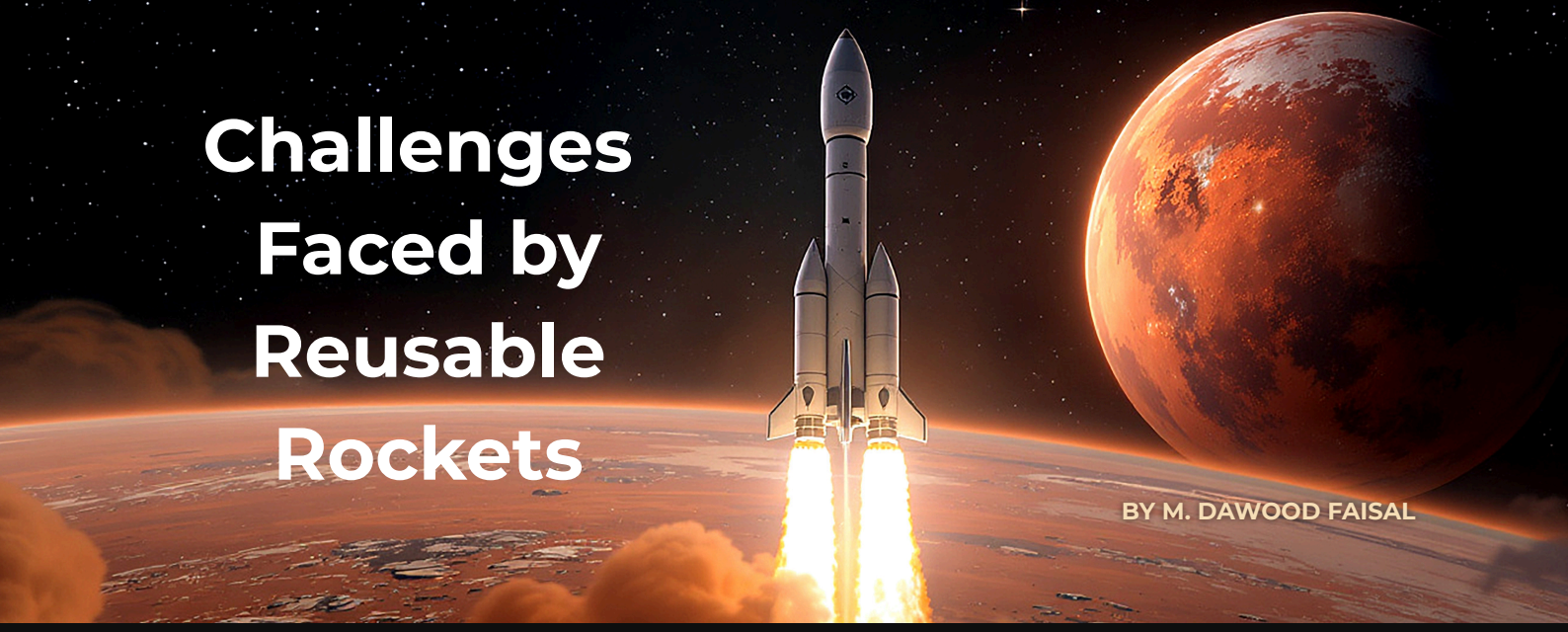
The U.S., China, and Russia are all believed to be researching or testing such capabilities. Some systems may be designed to blind or destroy satellites, while others could potentially be used for missile interception or even targeted ground attacks.

Satellites and Weather Manipulation: A New Frontier?

While still a subject of global debate and secrecy, weather modification through satellite-assisted technologies has emerged as a speculative but increasingly discussed element of modern warfare. Techniques like cloud seeding, once considered purely environmental tools, are now rumored to have strategic military value. Potential military applications include:

- Inducing floods or droughts in enemy regions
- Creating fog or storms for tactical advantage
- Using ionosphere heating to disrupt enemy radar

Challenges Faced by Reusable Rockets



BY M. DAWOOD FAISAL

Introduction

For centuries, humans dreamed of touching the skies and even crossing beyond them; however, the idea of rockets is not new. As early as the **9th Century in China**, soldiers used "fire arrows" these were small tubes filled with gunpowder that shot incendiary pre-industrial shrapnel, flames, and sparks during battles, and by the **13th Century**, these experiments in propulsion had already planted the seeds of modern rocketry.

At its heart, a rocket is a machine that works on a very simple principle: it burns fuel and throws the exhaust gases downward at very high speed, and in reaction, the rocket is pushed upward. This is what we call **thrust**.

But while rockets can climb the skies and pierce into space, their biggest problem for decades has been waste. Every rocket that launched into space would fall back and break apart, lost forever, as if we were throwing away an airplane after every single flight. This is where the revolutionary concept of **reusable rockets** came in. Instead of dying after one journey, these rockets are designed to fly into space, return safely, and land vertically, either on a launch pad, on a floating drone ship at sea, or (in the case of new designs like Starship), even into a giant "catch tower."

Historical Background

The dream of reusability is older than we think. Even in the early days of space exploration, scientists asked, *Can rockets be flown again?*

In the 1980s, NASA attempted this with the **Space Shuttle**. The shuttle orbiter itself was reusable, and the solid rocket boosters were recovered from the ocean and reused. However, the huge external fuel tank was always discarded, and the cost of refurbishing the shuttle was extremely high. It was only partly reusable, not the full vision that the engineers wanted.

The real breakthrough came in December 2015, when SpaceX successfully landed the Falcon 9 booster back on Earth. For the first time, a large orbital-class rocket returned in one piece, ready to fly again. Then just months later, Blue Origin's New Shepard also achieved repeated vertical landings for suborbital flights. Today, SpaceX is pushing the frontier further with Starship , the largest rocket ever built, designed to be fully reusable. If successful, it could significantly reduce the cost of space travel and make human missions to Mars significantly feasible.

From the fire arrows of ancient China to the shining towers of Falcon 9 and Starship, the history of rockets shows one theme: *humanity has always been chasing the dream of going higher and farther up, as if answering Iqbal's call that "**beyond the stars, there are more worlds to explore".***

Technical Challenges

Turning this dream into reality is full of difficulties. A reusable rocket faces some of the harshest conditions known to engineering. During liftoff, the engines burn at thousands of degrees, hotter than molten lava, and during reentry, the rocket collides with the atmosphere at hypersonic speeds, producing deadly heat and violent pressure. To survive, rockets need heat shields and protective systems, but even the strongest materials can struggle under these conditions.

Landing is another enormous challenge. Bringing down a tall, slender rocket and making it stand upright again is like dropping a pencil from the top of a skyscraper and expecting it to land on its tip without falling. Precision must be perfect, because even the smallest error in balance or navigation can then lead to a huge destruction.

Then comes the question of durability. Rocket engines are among the most complex machines ever made, and when used repeatedly, they face cracks, leaks, and stress on every part. The metal structures of rockets also become weaker after many launches and landings. Engineers must inspect each rocket thoroughly before every flight to ensure that no hidden damage leads to disaster.

Operational Challenges

Even when rockets survive their flights, preparing them for the next mission is not as simple as refueling an airplane. The process of transporting the boosters, inspecting every inch, repairing parts, and assembling them again requires huge facilities and expert teams.

Launch pads, fueling systems, and landing sites also need to be maintained constantly, which adds to the difficulty.

Companies dream of reusing rockets within days, but the reality is that it often takes weeks or even months before a booster is ready to fly again. The logistics of moving these giant machines, arranging new payloads, and resetting launch infrastructure make the process very complex.

Safety Challenges

Safety is the most serious concern for reusable rockets. Rockets are powerful machines, but they carry enormous risks, especially when humans are on board. History has already given us painful reminders. In 1986, the Space Shuttle Challenger exploded just after liftoff due to a faulty O-ring, killing all seven astronauts on board. In 2003, the Columbia shuttle disintegrated during reentry because of damage to its wing, once again taking seven lives. These tragedies show that even a tiny fault can lead to catastrophic loss.

Reusability increases these risks because every time a rocket is reused, the chances of hidden weaknesses grow. A small bolt, a valve, or a sensor may survive the first few flights but fail later, and predicting such failures is extremely hard. Testing rockets on the ground can only reveal so much because some problems only appear during the extreme conditions of spaceflight. For this reason, companies must spend enormous time and money on inspections, making safety a constant challenge.

Environmental Challenges

Reusable rockets may save money, but they still leave an impact on the planet. Most rockets today use kerosene-based RP-1 or methalox (methane with liquid oxygen) as fuel. These are better than older solid fuels, but they still release soot, carbon dioxide, and other chemicals that affect the air and atmosphere.

Another growing problem is space debris. Each failed stage, broken fragment, or dead satellite adds to the clutter in orbit. Scientists warn that if this continues, Earth may become surrounded by a dangerous belt of junk, making future launches risky. Some universities and companies, especially in China, are already working on plans to clean space and prevent it from becoming a graveyard of debris.

Rocket launches also cause local pollution. The noise is deafening, shaking the ground and disturbing wildlife. Communities near launch sites sometimes raise concerns about air quality, vibrations, and the long-term effects on the environment.

Despite these hurdles, progress continues. SpaceX is testing Starship, aiming to make it the first fully reusable rocket system in history. Blue Origin is working on its New Glenn rocket, and Rocket Lab is preparing Neutron. NASA and European agencies are also investing in reusability, showing that the future of spaceflight will not be single-use or disposable.

At the same time, researchers are exploring better fuels, more advanced heat shields, and faster methods of inspecting rockets using artificial intelligence and robotics. If these succeed, rockets could one day be reused within hours instead of months, just like refueling a jet. This would make space travel cheaper, safer, and more routine than ever before.

Conclusion

Reusable rockets are more than machines; they are a symbol of human imagination and persistence. From the fire arrows of the 9th century to Falcon 9's historic landing in 2015, the story of rockets shows humanity's unending desire to climb higher and break new boundaries.
Yes, there are challenges: extreme heat, landing difficulties, structural fatigue, safety risks, logistical limits, and environmental concerns. But the benefits are extraordinary: reduced costs, greater safety, and the possibility of exploring Mars, the Moon, and even farther worlds.

Muhammad Dawood Faisal

Currently pursuing a BS in Aerospace Engineering at the Institute of Space Technology, is an active participant in national projects and competitions such as SUPARCO's CANSAT competition.
He has built drones and model rockets, and contributes to the rocketry department, Rocket Propulsion System (RPS) of Space Society as a technical member.
His passion is to explore aerospace innovations and advance Pakistan's presence in space technology.

Panpsychism: When the Universe Itself is Alive

by RAYYAN SAGHEER

When humans first measured the movements of the stars, they did more than build calendars or predict eclipses. They encountered the disturbing possibility that the cosmos was not inert but structured with a precision that suggested intent. The apparent harmony of the heavens pressed a question that still unsettles scientists today: could awareness itself be a fundamental property of space? What began as myth eventually gave way to early cosmological models, yet beneath both lay the same suspicion that the universe was not simply adrift in darkness, but something alive, patterned, and possibly aware of its own existence.

Ancient cultures framed this insight through the tools they had at hand. Mesopotamian astronomer-priests mapped planetary motions with mathematical rigor and read in them the decisions of conscious powers. Greek thinkers like Thales and the Stoics proposed that the mind was not an emergent accident, but intrinsic to matter itself, suffusing the stars and planets with rational order. Even Roman writers such as Cicero and Seneca, often skeptical of superstition, acknowledged the possibility that the cosmos itself possessed a kind of soul. These were not idle myths but rather attempts to reconcile observation with ontology: the heavens were too orderly, too intelligible, to be lifeless.

From an overall Abrahamic perspective, everything in the universe is considered to be subject to God's command. From a Christian sense, panpsychism is generally resisted because consciousness is seen as a property uniquely bestowed by God to living beings. As philosopher Eleonore Stump notes, in traditional Christian thought, while creation reflects divine order, inanimate matter is not considered conscious. These views were developed by the Church to counter the existing Greco-Roman psyche, which attributed godly status to celestial bodies. In the Islamic worldview, the cosmos is believed to also be infused with divine essence, but Islamic thought emphasizes more strictly that all celestial bodies are solely obedient to God's will, moving in perfect harmony with divine order, which is a stance that could suggest a form of responsiveness in the cosmos itself. Philosophers and scholars such as Al-Farabi, Avicenna (Ibn Sina), and later Ibn Rushd saw the universe as orderly and intelligible, governed by natural laws while simultaneously manifesting divine conciousness. The stars, planets, and even seemingly, space were not inert; they carried signs of God's will and knowledge.

Modern philosophy of mind circles back to this unsettling possibility. The hard problem of consciousness is the difficulty of explaining how subjective awareness arises from neural activity, which has led some to argue that it does not arise at all. Instead, it may be fundamental, as intrinsic to the fabric of reality as mass or charge. Information theory has deepened this line of thought.

Shannon's entropy formula,

$$H(X) = - \Sigma\, p(x_i) \log p(x_i)$$

originally a tool for measuring uncertainty in communication, now suggests that information pervades every scale of the cosmos, from subatomic states to galactic dynamics. If consciousness is tied to the organization of information itself, then awareness may not be localized in brains alone, but spread throughout the architecture of space-time. However, despite the resurgence of panpsychism, which posits that consciousness is a fundamental feature of the universe, there remains little to no empirical evidence to suggest that stars, planets, or other celestial bodies possess awareness.

Philosophers such as Philip Goff and Rupert Sheldrake have explored the possibility of consciousness in cosmic entities, but these discussions remain speculative and lack scientific validation. The scientific community continues to view consciousness as an emergent property of complex neural networks, primarily studied within the context of biological organisms. If ever proven true, however, this idea borders on the terrifying, implying that when most astronomers observe the void, they may not just be studying a chaotic background but a system with its own form of experience which might be incomprehensible to us. The symmetry of orbital mechanics, the collapse of black holes, and even the massive distribution of galaxies and superclusters of them may not only describe physical events but also show traces of a cosmic mind. Ancient philosophers suspected that the heavens were alive, and modern science, through a system of information and complexity, may discover that they were not totally wrong, as space might not be empty after all. It may be conscious, and we are participants within its thought. If panpsychism holds any truth, then the night sky is far more than a visual for our telescopes. Every star, every swirling galaxy, every pulse of light may be part of a vast awareness stretching across the cosmos. The universe may not be a cold, indifferent void but a mind of unimaginable scale, and we, for all our science, are moving within it, observed in ways we can barely fathom.

Rayyan Sagheer

Rayyan Sagheer is a Bachelor of Science candidate in Aerospace Engineering at IST. His research interests include high-speed aerodynamics, aeroelasticity, and the aero-structural dynamics of fighter aircraft in transonic and supersonic regimes. He is also keenly interested in space systems and orbital mechanics.

Space Architecture
Crafting Home among the Stars

BY SIBGHA ANWAR

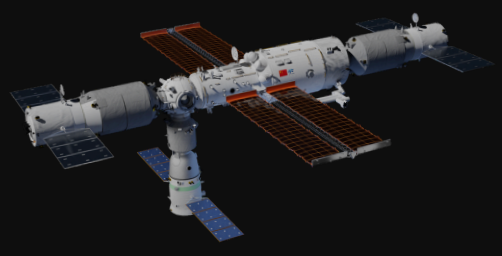
Let's talk about something you might never have heard before:

"Space Architecture"

It is the theory and practice of designing and building inhabited environments in outer space or other planetary surfaces. It is an architectural approach to spacecraft design and habitat systems. It relates directly to engineering but also encompasses aspects of human psychology, physiology, biology, and sociology. Designing a future space habitat requires not only engineering precision to enable humans to travel across long distances, but also a layout that nurtures and comforts the human mind, body, and spirit. Space architects make the space habitats human-centric so that astronauts will not just survive, but thrive. The spacecraft should not be conceived merely as a mode of travel to the stars, but as a home among them.

There are different types of Habitation Systems, a few of which are mentioned below with their pros and cons:

- **Rigid Modules:** They are strong, reliable, ready-to-use, and require minimal assembly, but have payload constraints and are not cost-effective



- **Expandable Modules:** These offer a volume per unit, cost effectiveness, and less launch weight, but are vulnerable to micro-meteoroid damage, radiation, and long-term structural degradation.
- **Hybrid Habitats:** These combine rigid and inflatable aspects to increase the transport efficiency, usable volume, and structural integrity. These habitats consist of a hard shell for core living spaces, with additional sections created using inflatable modules

- **In-situ Resource Utilization Habitats** They are the ones fabricated using local resources like Lunar or Martian regolith using 3D Printing by semi-automated systems.

Now that we have talked about some of the types, let's also look at a few challenges we come across while designing Habitation Systems. Vacuum habitats need to have a pressure of approximately 1 atm to sustain astronauts. It also puts outward stress on the habitats because air is continuously trying to escape, and even a single millimeter leak can cause instant decompression, which can be life-threatening.

Vast distances and payload constraints also need to be considered, as it is not feasible and cost-effective to send massive or heavy-weight structures over long distances. If we talk about sending deliverables to the Moon and Mars, the missions can take days even months, that

calls for multi-functional systems and ISRU. Cosmic Radiation is also a critical hazard for long-duration habitats; it can increase the risk of cancer, DNA damage, and threaten the integrity of structural materials, reducing the lifespan of the habitat.

Apart from these, factors such as extreme temperature, regolith contamination, exposure to space debris & micrometeoroids, micro-gravity or low gravity, and the presence of harsh and uneven terrains on planetary surfaces also need to be considered carefully.

Lack of resources and infrastructure is also a critical problem because frequent trips cannot be made to Earth, so the available space and tools must be used strategically.

Space Habitat Designing:

While designing habitat systems, different techniques are used such as zoning, insights from behavioural psychology, multifunctional spaces, and others. In simple words, zoning means separating busy and private areas; it involves acoustic and visual zoning. Private zones like sleeping quarters are placed away from high-traffic regions to avoid disturbing the astronauts, whereas communal zones like dining rooms or workstations are in the central regions, so that they are easily accessible to all. Crew movement paths can be mapped to avoid congestion, and lights can be adjusted to support circadian rhythm. Apart from that, different colours can be used for mood regulation. Since available space is limited, an exercise room can also be used as a meeting room.

Space habitats are designed through an engineering-focused approach, which is undoubtedly important. However, aptly integrating space engineering with space architecture can lead to space habitats that are not only efficient and durable but also human-centric, creating environments that feel like ***true homes within a spacecraft.***

Do you know?

Galina Balashova designed the interiors of Soyuz Spacecraft, Salut, and Mir space stations. She was part of the Soviet Space Program and was designing the interior spaces of spacecraft before there was any such position as a Space Architect.

Sibgha Anwar

Sibgha is a mechanical engineering undergraduate with strong focus on human spaceflight and space exploration, which incentivizes her to explore the human and technical aspects of crewed space missions while developing skills in engineering. Her leadership and global training highlights her commitment to collaborative innovation.

The Boötes Void: The Universe's Great Nothingness

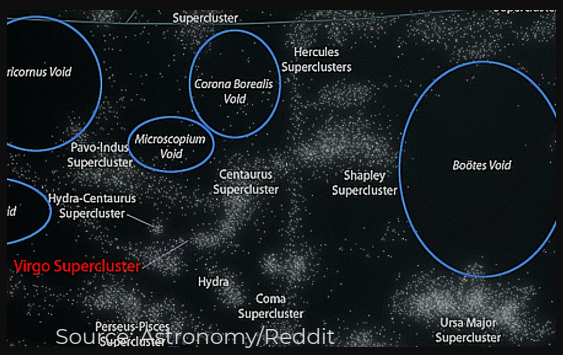
by HARIS AHMED

On this rocky little planet we call Earth, humanity has dared to peer beyond its skies, mapping stars, galaxies, and structures billions of light-years away. With each discovery, we feel as though we are beginning to understand the grand design of the universe. Yet, for all the wonders of exploding stars, swirling galaxies, and mysterious black holes, one of the universe's most unsettling secrets is not about what is there, but what is missing. This chilling mystery is known as the Boötes Void; a vast and seemingly impossible region of near-nothingness.

A Desert in the Cosmos

Discovered in 1981 by Robert Kirshner and his colleagues, the Boötes Void was spotted almost by accident while they were surveying galaxies in the constellation Boötes, almost 700 million light-years from Earth. Instead of finding clusters of galaxies racing away with cosmic expansion, the astronomers stumbled upon an eerie cosmic desert or, we can say, an enormous hole in the distribution of galaxies. The scale of this void is mind blowing: it spans 350 million light-years in diameter, making it one of the largest known voids in the observable universe. To put that into perspective, if the Milky Way were placed at its center, humanity might not have realized other galaxies even existed until the mid-20th century. How weird is that!

By all standard models of cosmic distribution, the Boötes Void should contain around 10,000 galaxies, swarming with stars, planets, and nebulae. Yet, after decades of searching, astronomers have found only about 60 galaxies scattered within it which looks like a whisper in the cosmic silence.



Source: Astronomy/Reddit

The Problem with Nothingness

Voids in the universe are not unusual. Cosmic structures form a "web" of galaxies and dark matter, leaving behind empty regions in between. But the Boötes Void is unnervingly large. It is so vast that its very existence seems to stretch the limits of our current understanding of cosmology.
The questions it raises are profound:

How did such a void form?
Why is it so perfectly placed in between walls of galaxies?
Does its size suggest the universe is older than we think?

As one scientist, Greg Aldering, pointed out: if Earth had been located inside the Boötes Void, humanity would have believed for most of history that the Milky Way was the entire universe.

Theories Behind the Mystery

Over the years, several theories have been proposed, each offering possibilities but no certainty:

1. Dark Energy Disturbances

One idea suggests that some unknown object or phenomenon inside the void is producing or pushing out dark energy, a mysterious force driving the accelerated expansion of the universe. If true, this might explain why galaxies are so scarce inside the void. But dark energy remains poorly understood, leaving this theory speculative at best.

2. A Colossal Black Hole

Another hypothesis imagines a super-massive black hole, or even a cluster of them at the void's heart, pulling galaxies inward and leaving behind emptiness. But the physics of black holes on this scale would challenge what we know about cosmic evolution and, interestingly, raise doubts about aspects of the Big Bang theory.

3. Soap-Bubble Merging

Perhaps most compelling is the explaination that the Boötes Void formed through a natural process of smaller voids merging, like the way soap bubbles combine into larger spheres.

Supporting this idea, some of the galaxies within the void appear stretched into tubelike shapes, possibly remnants of old boundaries between smaller voids. This would mean the void is not a singular anomaly, but a grand result of the intricate cosmic web knitting itself together.

A Challenge to the Big Bang?

What makes the Boötes Void particularly upsetting is its potential challenge to our most fundamental model of the universe. For such a gigantic void to form naturally, the universe might need to be much older than the 13.8 billion years suggested by the Big Bang model. While most scientists still firmly support the Big Bang, anomalies like the Boötes Void remind us that our understanding of cosmic history may not yet be complete.

A Mystery Waiting in the Dark

The Boötes Void is not just a region of emptiness; it is a symbol of how much we have yet to uncover. It is humbling, even frightening, to imagine such a monstrous desert of nothingness lurking in a universe we once believed to be filled with light everywhere. For now, the void keeps its secrets. But with advancing telescopes, improved simulations, and deeper surveys of the cosmic web, scientists hope that one day the riddle of the Boötes Void will be solved. Until then, it remains one of the most haunting and overwhelming mysteries of the universe.

A reminder that sometimes,

the greatest wonder lies not in what exists, but in what doesn't

HARIS AHMED

A Space Science student with a strong passion for astronomy and space exploration, Haris Ahmad is dedicated to understanding complex scientific concepts and making them accessible to everyone. Through scientific writing and educational outreach, he has published articles that simplify advanced topics in astronomy and physics, helping bridge the gap between scientific knowledge and public understanding.

Mars, Machines, and Minds: Women Shaping the Future of Planetary Science

by HAFSA AKHTAR

Mars exploration today is shaped not only by advanced robotics and artificial intelligence, but also by the growing presence of women in planetary science. Behind mission simulations, navigation systems, and AI models are researchers and engineers whose contributions are becoming increasingly visible. Women are no longer working at the margins of space research; they are part of the framework that sustains it.

Mars itself continues to draw scientific attention in a way few other planets do. Its crimson surface, marked by ancient river valleys and shifting dust storms, suggests a world that may once have shared similarities with Earth.

For decades, scientists have studied its geology, atmosphere, and climate which wasn't simply out of curiosity, but to confront a question that has followed humanity for centuries:

"Are we alone?"

Exploring Mars today involves far more than telescopes and theoretical calculations. Orbiters equipped with instruments such as the Context Camera (CTX) and the High Resolution Imaging Science Experiment (HiRISE) map its terrain in remarkable detail. Rovers examine soil chemistry, and landers monitor seismic activity beneath the surface. Each mission produces an overwhelming stream of data containing high-resolution images, atmospheric measurements, mineral compositions, and long-term climate records.

Making sense of this information depends not only on rockets and robotics, but increasingly on artificial intelligence (AI). Machine learning systems sift through millions of spacecraft images, identifying patterns that might escape even trained observers. Autonomous navigation allows rovers to respond to their surroundings in real-time without waiting for instructions from Earth. Predictive models simulate the Martian weather and atmospheric behavior, helping scientists refine mission strategies before launch.

In many ways, exploration now unfolds both on the Martian surface and within powerful computational systems that can process data across millions of kilometers. Yet fundamentally, behind every complex algorithm is a human mind.

The development of Mars research mirrors a broader shift within STEM fields. Disciplines that were once limited in representation are gradually becoming more inclusive. Women now contribute across the full spectrum of planetary missions from propulsion systems and robotics to AI model design and planetary data analysis.

Their involvement does more than signal progress; it strengthens the quality and depth of scientific inquiry itself. For countries like Pakistan, the intersection of AI and space science represents a very powerful opportunity. Many institutions are advancing aerospace engineering, remote sensing, and computational sciences. They are nurturing a generation capable of contributing to global exploration efforts.

As AI becomes increasingly integral to astronomy and planetary research, students with strong analytical and programming foundations can meaningfully engage with space science —even from Earth.

This is where mindset becomes crucial. Space exploration is not only about reaching planets; it's about expanding intellectual boundaries at home. As students and researchers, we must consciously make space for space in our universities, in our research priorities and in our ambitions. When we create room for scientific curiosity and interdisciplinary collaboration, we position ourselves to participate in the next era of exploration rather than merely observe it.

Representation matters because innovation demands diverse thinking. Challenges such as sustaining life on Mars, decoding planetary geology, or designing long duration missions require multifaceted approaches. Diverse teams consistently produce more resilient solutions. When planetary science reflects the full spectrum of human talent, its progress becomes stronger and more sustainable.

Mars is often described as humanity's next frontier. Discussions of sustainable habitats, autonomous systems and interplanetary missions continue to evolve. Yet the future of exploration will not be defined by technology alone. It will be shaped by engineers who design intelligent systems, the scientists who interpret planetary data and the visionaries who determine what exploration should represent. Mars, machines and minds are inseparable.

The Red planet challenges us to innovate. AI enables us to explore more deeply and inclusive participation ensures that the story of planetary discovery is expansive, responsible and forward looking.

As we look towards a future in which humans may one day stand on Martian soil, the defining question is not only whether we can reach it but whether we are preparing ourselves to lead, contribute and innovate when the moment arrives.
The future of planetary science belongs to those willing to make space for space.

Hafsa Akhtar

A Bachelor of Science student in Space Science at the Institute of Space Technology; Hafsa's interests include planetary science, particularly Mars exploration, and the application of artificial intelligence in space research. She currently serves as President of Space Society IST, where she works to promote scientific engagement and collaborative learning.

The Martian Micro-Factory: Engineering a Bio-economy Beyond Earth

by SAMI UR REHMAN

A factory that is so small that you can't see it with your eyes; one that can make food, medicine, and even fuel. Now imagine that the factory was working

"NOT ON EARTH, BUT ON MARS".

This isn't science fiction. Scientists are already making it a reality using synthetic biology, a field in which cells are treated like programmable machines. By redesigning microbes such as bacteria and yeast, researchers are finding ways to help astronauts survive the long and dangerous journeys of space exploration.

The Problem: We Can't Carry Everything

A crewed mission to Mars and back would take almost 3 years. It means astronauts would need food, medicine, and supplies that stay good for the entire trip. But there's a catch: vitamins degrade over time, drugs lose potency, and launching heavy cargo into space is wildly expensive; between $2,700 and $54,000 per kilogram.

Carrying everything from Earth simply is not practical. The solution? Stop taking everything. Start making things in space.

The Solution: Tiny Living Factories

Scientists are using genetic engineering to turn harmless microbes into "microscopic factories."

They can program yeast to make nutrients, bacteria to produce materials, or even build systems that generate fuel.

NASA's BioNutrients project is a perfect example. Researchers used CRISPR gene-editing to reprogram baker's yeast to produce antioxidants such as beta-carotene and zeaxanthin, nutrients normally found in vegetables. Astronauts aboard the International Space Station have already tested the process: they simply add water to a pouch of dried yeast, incubate it for a few days, and harvest fresh nutrients.

In the future, astronauts might choose exactly what they need: Vitamin C, Vitamin K, or even caffeine, and have a microbe make it on demand.

Using Mars to Live on Mars

The next big leap is to stop relying on Earth entirely. Instead of shipping growth media and supplies from home, scientists are figuring out how to feed microbes with what's already on Mars.

The Martian atmosphere is mostly carbon dioxide, toxic to humans, but perfect for engineered microbes.

These microbes could convert CO_2 into building materials, plastics for 3D-printed tools, or even rocket fuel for the return trip. This would turn Mars' hostile environment into a resource for survival, and a step toward building a truly circular space economy.

Making Tough Microbes

Mars is not a friendly neighbor. It is extremely cold, bone-dry, and bathed in radiation. Its soil even contains perchlorate, a chemical we use as bleach on Earth.

To prepare microbes for such an extreme environment, scientists look to extremophiles; organisms that survive in nuclear accident zones, deep-sea vents, or toxic salt lakes. They are combining these survival traits into microbes that can handle radiation, toxic soil, and freezing temperatures.

Some researchers use a process called directed evolution, which rapidly mutates and selects microbes in the lab until they acquire the traits needed to survive on Mars.

Why This Work Matters

Building a bio-economy in space is about more than reaching Mars. It's teaching us how to live in closed-loop systems, where nothing is wasted and everything is recycled. These same principles can help us design sustainable food systems, renewable materials, and cleaner industries here on Earth.

When the first astronauts step onto Mars, it will be one of humanity's greatest achievements. But behind that giant leap will be trillions of tiny, engineered microbes - quietly working as miniature factories to keep those astronauts alive.

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Sami Ur Rehman

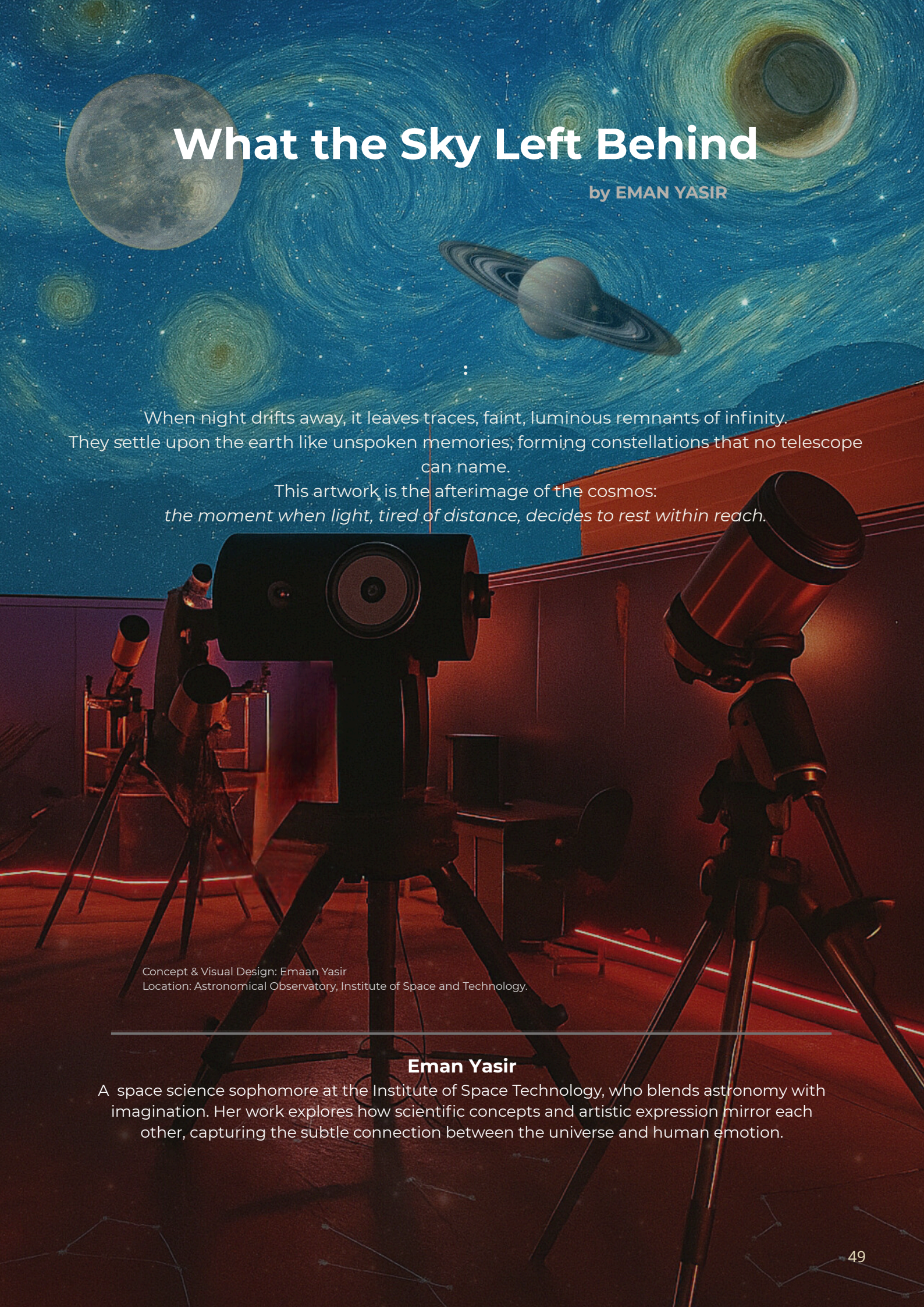
Sami Ur Rehman is an *undergraduate student of Biotechnology* at **Virtual University of Pakistan**, he serves as *General Secretary* of the **Environmental Protection Society**. He is passionate about synthetic biology, space biotechnology, and sustainable bioeconomy solutions. Sami is also the founder of an early-stage cancer therapeutics startup inspired by iGEM.

What the Sky Left Behind

by EMAN YASIR

:

When night drifts away, it leaves traces, faint, luminous remnants of infinity.
They settle upon the earth like unspoken memories, forming constellations that no telescope can name.
This artwork is the afterimage of the cosmos:
the moment when light, tired of distance, decides to rest within reach.



Concept & Visual Design: Emaan Yasir
Location: Astronomical Observatory, Institute of Space and Technology.

Eman Yasir

A space science sophomore at the Institute of Space Technology, who blends astronomy with imagination. Her work explores how scientific concepts and artistic expression mirror each other, capturing the subtle connection between the universe and human emotion.

Quantum Entanglement:

The Cosmic Thread Between Stars

by TAHIR SHAMIM

"When we measure one, we instantly know the other."

That strange idea might sound like magic, but it's real physics.
Quantum entanglement is one of the strangest and most beautiful discoveries in modern science. It happens when two tiny particles, like photons or electrons, become linked in such a way that whatever happens to one instantly affects the other, even if they are light-years apart.

Albert Einstein disliked this idea, calling it "spooky action at a distance." It seemed to break one of physics' most sacred rules: that nothing can travel faster than light. But decades of research and experiments have shown that entanglement is real. It doesn't send signals faster than light; instead, it reveals that the universe is far more deeply connected than we ever imagined.

Understanding Entanglement

In everyday life, if you flip two coins, each can land on heads or tails. In the quantum world, two "coins" can exist in both heads and tails at the same time, a state called superposition. When they become entangled, they share a single, combined state.

Physicists describe this using an equation:

$$\psi = \frac{1}{\sqrt{2}} (|\uparrow\rangle_A |\downarrow\rangle_B + |\downarrow\rangle_A |\uparrow\rangle_B)$$

In simple words, this means if one particle (A) is spin-up, the other (B) must be spin-down, and vice versa. They are perfectly linked. The moment you measure one, the other's state becomes known instantly, no matter how far apart they are.

This prediction has been confirmed again and again through Bell test experiments, which show that the results cannot be explained by any hidden classical mechanism. The universe really does behave this way.

Could Entanglement Exist Across the Cosmos?

Until recently, scientists could only study entanglement in laboratories across very small distances.

But now, physicists are asking a thrilling question:

Could this phenomenon exist on a cosmic scale?

Some believe it can. In the earliest moments after the Big Bang, the entire universe was tiny, dense, and extremely hot, conditions where particles constantly interacted. When space suddenly expanded during cosmic

inflation, those particles were stretched far apart but may have stayed quantumly connected.
If true, parts of the universe billions of light-years apart might still share hidden quantum relationships, invisible threads binding the stars themselves.

The Idea That Space Is Made of Entanglement

Physicist Leonard Susskind and others have proposed a remarkable theory called ER = EPR. It connects two big ideas: the Einstein-Rosen bridge (ER), which describes a wormhole, and the Einstein-Podolsky-Rosen paradox (EPR), which describes entanglement.

This theory suggests that when two particles are entangled, it is as though there is a tiny wormhole connecting them. Not a tunnel we could travel through, but a sign that the fabric of space itself might be woven from networks of quantum connections. On this view, the entire universe could be seen as a giant web of entangled relationships, space, time, and matter,

all tied together through invisible quantum threads.

Proof from the Stars

In 2017, researchers from MIT and the University of Vienna conducted an extraordinary test using light from distant quasars, which are galaxies billions of years old. They used photons from those ancient sources to decide how particles should be measured in an entanglement experiment.

Because that light had been traveling toward us long before Earth existed, it helped prove that quantum results cannot be influenced by local, hidden causes. In other words, the universe has been quantum since the beginning of time. It is humbling to think that the light that began its journey before our planet formed, helped confirm one of the deepest truths about nature.

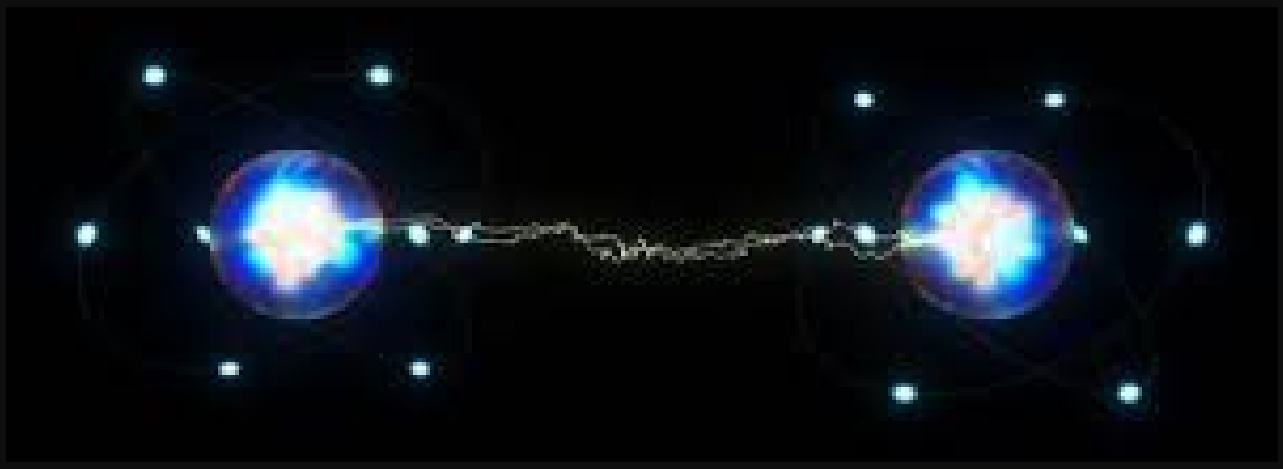
The Human Connection

Entanglement is not just a scientific mystery; it's also a philosophical one. It challenges the idea that anything is truly separate. If every particle in the early universe once shared quantum contact, then in some sense, we remain connected to the stars, galaxies, and cosmic dust from which we came.

We often see ourselves as small and isolated in a vast, empty cosmos. But quantum physics hints at something more profound: the same laws that shape distant galaxies also link the particles inside our bodies. *The universe may not just contain connections, it is connection itself.*

Conclusion

Quantum entanglement began as a strange thought experiment. Today, it is a foundation for real technologies like quantum computing, quantum cryptography, and teleportation of information. Yet beyond its practical uses, entanglement carries a quiet lesson about unity. It tells us that at the deepest level, the universe is not made of separate pieces, but of relationships, patterns of connection that stretch from the smallest particles to the most distant stars. Perhaps those invisible threads do more than tie particles together. Perhaps they remind us that we, too, are part of one vast, continuous whole, a universe made not only of matter, but of meaning.



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Tahir Shamim

Tahir Shamim is a Space Science student at the Institute of Space Technology. His work explores the idea of connection within the universe, how quantum entanglement, light, and cosmic structures reveal that everything in existence is part of one vast, interwoven reality.

Is a theory of everything possible in physics?

by MARYAM ALI BAIG

Introduction

The theory of everything is a hypothetical framework with the main purpose of tying together the physics of the universe – all known forces, the discovered subatomic particles, the fundamentals of the origin and creation of the universe – into a single, comprehensible principle.

Mainly, this theory would attempt to unify General Relativity and Quantum Mechanics, two of the most important pillars of modern physics. The initial ideas for such a theory likely began with Albert Einstein, who attempted to formulate a framework to merge relativity with electromagnetism, Although he was not successful, he brought forth the possibility that different forces could be described by a single theory.

Therefore, in subsequent decades, many other scientists carried out research to make this theory a reality, resulting in many new discoveries, breakthroughs and limitations. The most devastating and prevalent problem that surfaced while searching for a Theory of Everything (ToE) was that General Relativity and Quantum Mechanics turned out to be polar opposites. They are incompatible. To comprehend why, there is a need to understand the basics of both theories.

Understanding General Relativity and Quantum Mechanics

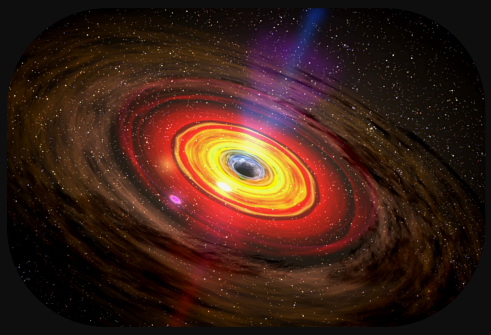
The Theory of General Relativity (GR) describes gravity as a feature of the geometry of space-time itself, and not as a force, as initially theorized by Isaac Newton. According to General Relativity, energy alters the geometry of space and time around it, causing straight lines to appear curved. Objects that travel along these curves seem similar to objects travelling in straight lines according to Newton's first law, which says that objects which travel in a straight line are not under the influence of a force, and, in relativity, the apparent curved lines are actually straight lines that are present in curved space. Therefore, gravity is simply the observation when objects follow Newton's first law in a curved space.

Quantum mechanics, through the "standard model," explains the other three forces of nature: the electromagnetic force, influencing charged particles, the strong nuclear force, holding nucleons together, and the weak nuclear force, regulating radioactive decays. While quantum particles have no analog in our familiar world, the Heisenberg uncertainty principle allows them in the subatomic world. Moreover, it also states that the properties of every particle can be described with a wave-function, which obeys a fundamental equation: the Schrodinger equation. A particle can have multiple values of a particular property. Each of these values are 'embedded' in the wave-function; when we measure the particle it can take on any of these values.

Hence, we acknowledge two important theories of modern science: one describes the universe on a macroscale, and the other, describes the behavior of particles on miniscule scales. Hence, scientists attempted to quantize gravity.

Issues Encountered

Unfortunately, it was soon discovered that Relativity gives nonsensical infinite values, when you try to scale it down to quantum size. Similarly, quantum mechanics runs into problems when it's expanded up to cosmic dimensions: Quantum fields carry a large amount of energy, even in seemingly empty space, and the amount of energy increases as the fields get bigger. Since energy and mass are directly proportional, increasing energy will increase the mass. Increase the quantum fields to a relativistic scale, and the amount of energy increases so significantly that it creates a black hole that causes the universe to collapse in on itself (Powell, 2015).



These revelations led to one conclusion– the current view of the subatomic particles and the current view of gravity were incompatible.

There must be a better theory to take their place. Thus began the quest for **the Theory of Everything**, resulting in the founding of many groundbreaking and **controversial theories.**

A few Candidates for the TOE

The leading candidate for a ToE is definitely string theory. Popularized in the late 1960s, It was originally developed as a model for describing interactions between two quarks. But, when the calculations for the energy and dynamics of strings were done, the results yielded a massless particle of spin 2, which was the hypothesized graviton: an undetected particle responsible for gravitational attraction.

This led physicists to speculate whether string theory could be a theory of quantum gravity; they found if they allowed fundamental particles like electrons and quarks to behave like microscopic strings, they could derive the equations of general relativity without any further hustle. This is why string theory is a very popular candidate.

However, a few problems surfaced: The very simplest string theory, bosonic string theory, requires 25 dimensions of space and 1 of time–26 dimensions in total. String theorists would state that the additional dimensions are very microscopic, and they cannot be perceived by normal eyes, or by current experiments. But, when looking at the level of strings, the microscopic dimensions are imperative for yielding the results we need.

With the passage of time, string theory went through many variations, ultimately leading to the creation of the M-Theory, the unification of all string theories. M-Theory connected various string theories using the fact that many shared dualities (which are symmetric connections between two string theories). Thus formed a universal string theory; with 11 dimensions, and with all the predictive power and accuracy of the collection of the various sub-theories. Even today, M-theory is the most widely accepted string theory.

The easiest way to prove string theory is to detect the microscopic strings. However, they apparently exist at the smallest length possible: the Planck length. It would take immense energy to break apart our fundamental set of particles, let alone detect strings. There may be a need for a more advanced particle collider to carry out these kinds of experiments. Another way to detect it is finding the microscopic dimensions which is just as unlikely: finding dimensions defined to be undetectable.

Along with the multiple dimensions needed for strings, there is another huge problem.

> We don't know which universe we live in.

In order for the multiple dimensions to exist, there has to be some particular configuration of those extra dimensions.

There are currently 10^{500} possible configurations that could give the laws of physics for our universe, but it's not clear which one is true. Physicists believe that each configuration corresponds to a whole different universe, but then we don't know which of those universes our reality is.

Besides string theory, there is another popular ToE referred to as Loop Quantum Gravity (LQG). Albert Einstein taught that space and time are joined in one entity: space-time. But LQG treats both space and time as separate quantities. According to the LQG theory, space is not continuous but is instead broken up into tiny units called quantas which are 10^{-35} meters across. These quantas of space are then connected by links to form the space we experience.

LQG predicts that the Big Bang was not the beginning of our universe. Instead, our universe came to be after the collapse of a precursor in an event known as the Big Bounce. LQG predicts the existence of a portal to another universe instead of a singularity at the center of a black hole.

Although LQG makes some interesting predictions, it goes against the basic idea of the theory of relativity, which has proved to be reliable. Therefore, space and time might not be as distinct as theorized by LQG.

Conclusion

In conclusion, it is clear that Physicists would like to show that all the forces, including gravity, are the consequences of a single symmetry principle. But this drive to have a concise, fixed and somewhat 'aesthetically pleasing' is a naive desire that may not be in accordance with nature.

A theory of everything may exist, but it might be messy and chaotic. Even if such a theory does exist—a simple set of equations that can be neatly comprehended—it'll be highly compact and abstract, and may not be that useful. Einstein's theory of gravity is a sophisticated theory, but its consequences are hard to deduce. Similarly, it's likely that the consequences of a theory of everything will be hard to determine as well and will take generations of effort.

Even if physicists find a ToE, they will likely be left with the question of why this set of mathematical equations rather than another, given the inherent unsatisfiable nature of humans. Still, humans are also naturally curious, and will keep on persisting until a ToE is produced, even if there's a possibility that it might not exist.

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Maryam Ali

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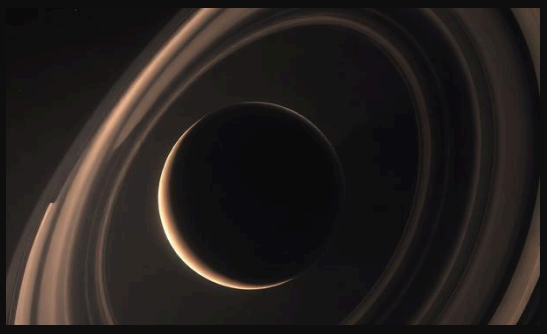
INBOUND

Cosmic Dust

by QURAT UL AIN

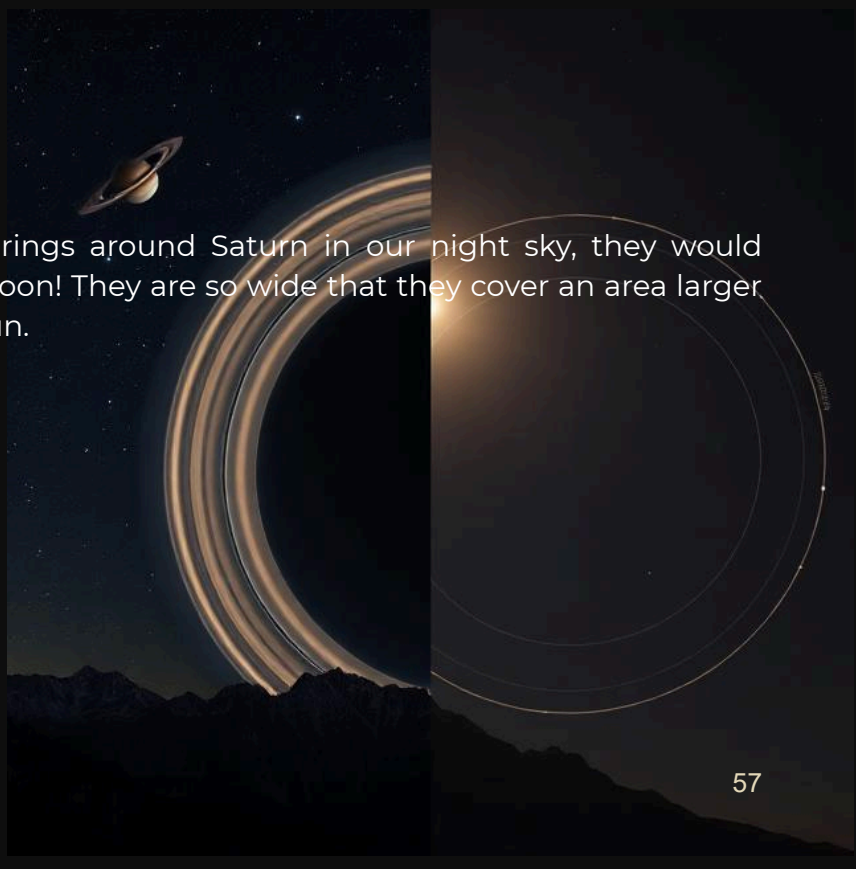
Saturn's rings are beautiful, but .....
J1407b's ring system is roughly 200 times bigger... 90 million km across.



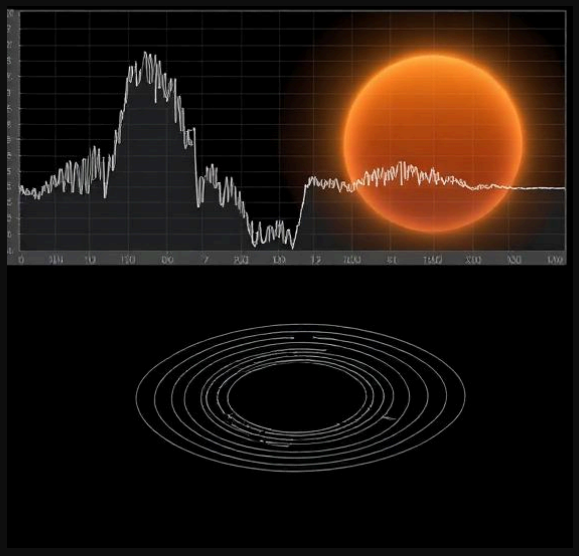
Size:
J1407b's hypothetical ring system is roughly 200 times bigger than Saturn's. The rings stretch out about 90 million kilometers (56 million miles).

Scale:
If you could magically place J1407b's rings around Saturn in our night sky, they would appear many times larger than a full moon! They are so wide that they cover an area larger than the orbit of Mercury around our Sun.

Structure:
Astronomers believe this giant ring system is made up of over 30 separate rings of dust and rock.



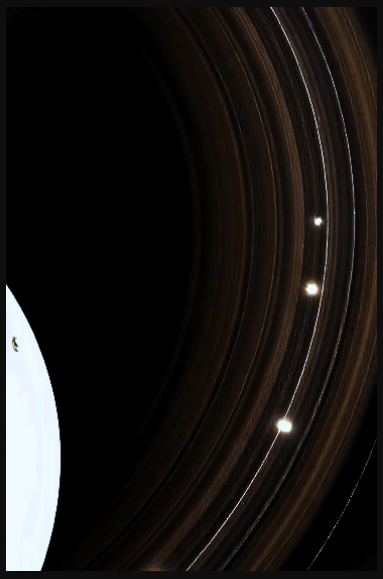
How Did We Find Something So Far?



We can't actually see J1407b or its rings directly with a telescope because it's too far away (about 434 light-years from Earth). Instead, astronomers found it using a trick called the transit method.

In 2007, scientists noticed that the light coming from the star J1407 suddenly became incredibly dim – it dropped by as much as 95%! This dimming lasted for weeks, showing a complex, changing pattern as something huge passed in front of the star.

The only explanation for such a long, deep eclipse was a massive object surrounded by a gigantic ring system. The rapid dips and rises in the star's light allowed scientists to map the many individual rings and the gaps between them.



Moons in the Making

Those dark gaps in the rings are one of the most exciting discoveries about J1407b. Scientists think these gaps are being carved out by exomoons (moons of the exoplanet) that are currently forming.

The entire system is very young, and over the next few million years, astronomers expect the dust and rock in these rings to clump together, turning this magnificent ring system into a whole new family of moons. J1407b gives us a rare, spectacular look at how moons are born around distant planets.

Image Credits: Top image: NatGeo / Other visuals: DeepAI

Qurat Ul Ain

An undergraduate student in the Space Sciences program at the Institute of Space Technology Islamabad, with academic interests including research work and reading articles. She plans to pursue further research in Astronomy.

Numerical Solutions to the law of Universal Gravitation for a Two Body system

by Zain Ul Abideen.

Abstract

This study details the procedure for solving the Newton's law of Universal Gravitation for a two body system in two dimensions. A total of 4 second order ordinary differential equations were deduced, which were further broken down into 8 first order ordinary differential equations to be solved in Scilab. The values of the constants, and the initial conditions were set to trivial values, and the results were visualized in a scatter plot.

Introduction

Newton's law of Universal Gravitation provides a good approximation of the Gravitational Force for everyday use-cases. For a more sophisticated explanation, Einstein's General theory of Relativity is used. Analytical solutions to the two body problem are possible but are very tedious and not optimal for our use case.

Thus numerical methods were used. The differential equations were solved by the built-in ODE solver in the Scilab language.

An alternative option would be converting the differential equation to a finite difference equation, and using the Euler's Method to solve it iteratively. The choice of the Scilab language was made because of its wide ray of built-in functions for complex algorithms, and because the software package is open-source and cross-platform.

Results and Discussions

Let us start with the vector form of the Newton's law of universal gravitation.

Consider two masses, m1 and m2, located at coordinates (x_1, y_1), (x_2, y_2) on a two-dimensional plane. The $\mathbf{r}$ is defined to point from the mass m_1 to m_2.

Let's now explore the mathematical expression of the force that the mass m_1 exerts on m_2. We know from Newton's second law that force causes a body to accelerate. The gravitational force between two bodies is given by:

$$\mathbf{F}_{12} = G\frac{m_1 m_2}{r^3}\mathbf{r}$$

Here, r is the vector from mass m_1 to m_2. The acceleration of mass m_1 due to m_2 is:

$$m_1\frac{d^2\mathbf{r}}{dt^2} = \frac{Gm_1m_2}{r^2}\hat{\mathbf{r}}$$

Where r_1 is the position vector of mass m_1. Since our analysis is constrained to two dimensions, we can write the vector in terms of Cartesian components:

$$\frac{d^2(x_{12}\hat{\mathbf{i}} + y_{12}\hat{\mathbf{j}})}{dt^2} = \frac{Gm_2}{[(x_2 - x_1)^2 + (y_2 - y_1)^2]^{3/2}}[(x_2 - x_1)\hat{\mathbf{i}} + (y_2 - y_1)\hat{\mathbf{j}}] \tag{4}$$

Separating the x and y components gives two second-order ordinary differential equations:

$$\frac{d^2}{dt^2}x_{12}\hat{x} = \frac{Gm_2}{[(x_2 - x_1)^2 + (y_2 - y_1)^2]^{\frac{3}{2}}}(x_2 - x_1)\hat{x} \tag{5}$$

$$\frac{d^2y_{12}}{dt^2} = \frac{Gm_2}{[(x_2 - x_1)^2 + (y_2 - y_1)^2]^{3/2}}(y_2 - y_1) \tag{6}$$

Similarly, for the other mass (remembering $F_{12} = -F_{21}$), the second-order equations are:

$$\frac{d^2}{dt^2}(x_{21}\hat{\mathbf{i}} + y_{21}\hat{\mathbf{j}}) = \frac{Gm_1}{[(x_2 - x_1)^2 + (y_2 - y_1)^2]^{3/2}}[(x_1 - x_2)\hat{\mathbf{i}} + (y_1 - y_2)\hat{\mathbf{j}}] \tag{7}$$

Writing the components separately into two differential equations is going to segregate the work. This way, the calculations for each of the co-ordinate can be done separately, and then the result can be superimposed. This fact results directly from the definition of vectors as superpositions of their components.

Acceleration of body 2 relative to body 1:

$$\frac{d^2x_{21}}{dt^2} = \frac{Gm_1}{[(x_2 - x_1)^2 + (y_2 - y_1)^2]^{3/2}}(x_1 - x_2) \tag{8}$$

$$\frac{d^2y_{21}}{dt^2} = \frac{Gm_1}{[(x_2 - x_1)^2 + (y_2 - y_1)^2]^{3/2}}(y_1 - y_2) \tag{9}$$

Solving these 4 second order ordinary differential equations simultaneously would give us the trajectories of both the masses. The differential equation solver in Scilab can only solve a first order differential equation at a time, thus we would need to make substitutions to break each of those second order differential equations into two first order ones. At the end, we would need to solve the following 8 first order ordinary differential equations simultaneously to get the trajectories of both the masses in two dimensions:

Position derivatives:

$$\frac{dx_{12}}{dt} = V_{x12} \tag{10}$$

$$\frac{dy_{12}}{dt} = V_{y12} \tag{11}$$

$$\frac{dx_{21}}{dt} = V_{x21} \tag{12}$$

$$\frac{dy_{21}}{dt} = V_{y21} \tag{13}$$

Velocity derivatives (due to gravity:

$$\frac{dV_{x12}}{dt} = \frac{Gm_2}{[(x_2 - x_1)^2 + (y_2 - y_1)^2]^{3/2}}(x_2 - x_1) \tag{14}$$

$$\frac{dV_{y12}}{dt} = \frac{Gm_2}{[(x_2 - x_1)^2 + (y_2 - y_1)^2]^{3/2}}(y_2 - y_1) \tag{15}$$

$$\frac{dV_{x21}}{dt} = \frac{Gm_1}{[(x_2 - x_1)^2 + (y_2 - y_1)^2]^{3/2}}(x_1 - x_2) \tag{16}$$

$$\frac{dV_{y21}}{dt} = \frac{Gm_1}{[(x_2 - x_1)^2 + (y_2 - y_1)^2]^{3/2}}(y_1 - y_2) \tag{17}$$

Solving the eight of the above simultaneously with the appropriate constants and initial conditions produced the accurate results.

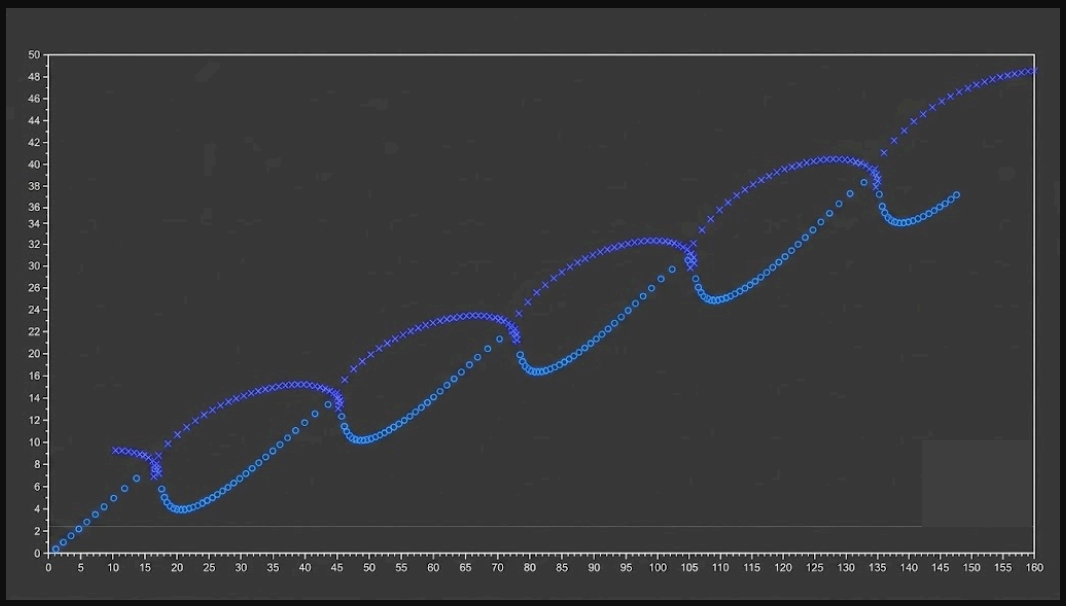


Figure 1: The figure depicts the trajectory of two masses gravitationally bound to each other. The trajectory of the first mass, with initial position (0, 0) is given by the circles whereas the trajectory of the second mass, with initial position (10, 10) is given by the crosses. Both the masses were given some random but appropriate initial velocities.

Numerical Solutions to the one dimensional Heat Equation

by Zain Ul Abideen.

Abstract

This study details the procedure for solving the one dimensional heat equation using the finite difference method. The initial conditions and the boundary conditions have to be provided. The final iterative formula for the solution to the partial differential equation was implemented in the Scilab language using nested for loops. The results were visualized by looping over all the rows in the resulting matrix.

Introduction

The partial differential equations are different from the ordinary differential equations in the sense that the functions involved here are of more than one variable. The particular differential equation that was solved in this study was the Heat Equation in one dimension. This particular choice was made because the methodology can be applied to solve the Schrodinger equation in computational quantum mechanics, as it takes the same form as the Heat Equation.

This partial differential equation was solved numerically using the Finite Difference Method. Analytical solutions are also possible but were unsuited for our application. The differential equation was solved on a two dimensional grid by implementing the final iterative formula using nested for loops.

The choice for the Scilab language was made because certain design choices made working with matrices in Scilab much easier than alternatives, and because of the fact that Scilab is open-source and cross-platform.

Results and Discussions

Let's start our analysis with the one dimensional form of the heat equation:

$$\frac{\partial U}{\partial t} = a^2 \frac{\partial^2 U}{\partial x^2} \qquad (1)$$

To convert the above differential equation into a form that can be solved numerically, we need to make substitutions for the first and the second derivative operators. We will use the definition of derivative to make the substitution

$$\frac{\partial U(x,t)}{\partial t} \approx \frac{U_x^{t+1} - U_x^t}{\Delta t} \qquad (2)$$

Where the subscript gives the position index, and the superscript the time index. This notation will turn out to be a convenient form for iterative solutions. It was found that not all expressions for the 2nd derivative produce the correct results. In this study, I will be using the form that did produce correct results:

$$\frac{\partial^2 U(x,t)}{\partial x^2} \approx \frac{U_{x+1}^t - 2U_x^t + U_{x-1}^t}{(\Delta x)^2} \qquad (3)$$

Now, making the substitutions into the partial differential equation and expanding:

$$\frac{U_x^{t+1} - U_x^t}{\Delta t} = a^2 \frac{U_{x+1}^t - 2U_x^t + U_{x-1}^t}{(\Delta x)^2} \quad (4)$$

Multiplying both sides by Δt:

$$U_x^{t+1} - U_x^t = \left(\frac{a^2 \Delta t}{(\Delta x)^2}\right)\left(U_{x+1}^t - 2U_x^t + U_{x-1}^t\right) \quad (5)$$

Since we are solving for the time evolution, we will isolate the term that provides that. We will also define a place-holder variable λ for the constants.

$$U_x^{t+1} = U_x^t + \lambda\left(U_{x+1}^t - 2U_x^t + U_{x-1}^t\right) \quad (6)$$

Initial and Boundary Conditions

To solve the above equation iteratively, we need two sets of conditions; the boundary conditions and the initial conditions.

The initial conditions would provide the spatial state at an initial time. The iterative formula will give us the time evolution of that state as given by the partial differential equation. For the initial condition, we would need a function of the spatial co-ordinate x i.e. f(x).

Since the value in next step of time depends upon multiple values in the previous step, the initial condition would not provide the sufficient details for the iterative process to begin. We would also need the boundary conditions i.e. the values of the positions −∞ and +∞ for all the instants of time.

The most common boundary conditions are that the functions vanish at both of those extreme ends for all instances of time. Of course we would approximate these extreme ends with some finite but large numbers.

The whole iterative process for the solution of the Heat Equation is detailed in the diagram below. It is clearly evident how we need both the initial and the boundary conditions to start the iterative process, and how the iterative process could be modelled with nested for loops.

The number of points in the length dimension are directly proportional to the quality of the plot. They should be set to a sweet number and then left alone. The number of points in the time dimension are directly proportional to the time the 'animation' lasts. It can be set to any number.

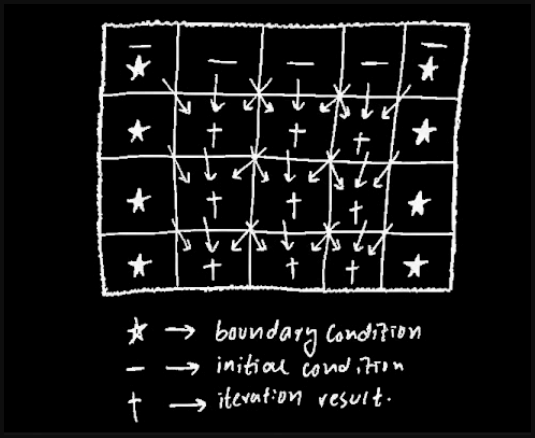


Figure 1: The horizontal blocks give the position co-ordinates, and the vertical blocks give the temporal co-ordinates, with an origin in the upper left corner depending upon the nature of study. All the different rows of the resulting matrix were plotted using the for loop.

Zain Ul Abideen

Zain is an alumnus of the Space Science program at the Institute of Space Technology. He holds a strong interest in space numerics, computational modeling, quantum physics, and advanced theoretical mechanics. His academic pursuits are driven by a deep curiosity about orbital dynamics, high-energy phenomena, and the mathematical foundations underlying aerospace systems. He has also contributed valuable articles for volume 1 of The Cosmic Herald and worked as the Director Publications

ALL IS NOT LOST

Author: Izza Fatima Hassan
Co-Author: Zaid Ali Hyder

A silence close to death draped the land, in the middle of the night; thick as velvet pressing against rooftops and fields alike. It was broken by the far-off susurrus of running wheels on roads and a solitary lullaby of a plane making its way across the stars.
Then a small night chorus of insects began; a diverse soundscape: everyone asleep.
The gentle winds whispered sobbing sounds from the north-east Punjab all the way to Qila Sheikhupura:

Qila**:** Lahore! Is that you?
Lahore**:** Of course it's me, can't you tell?
Qila**:** No. Not if we all look the same.
Lahore**:** I don't Qilaa..., neither do I feel the same now...
The silence deepened and the winds traveled faster blowing toward south-west
Multan**:** Lahore, skies are meant to resemble one another.
Lahore, almost to itself: Not me, there's only one of me in all the world.
Multan**:** You're the roof to the country's culture, the music and the art.
Lahore**:** And you think it can breathe any longer?
Multan**:** Oh Lahore, sky over vibrant souls, let not sadness rest on you.
Lahore (bitterly): I would, if it were light enough to lift.
Balochistan, calm and bright, looked down and smiled, taking a deep breath. Yet, in that profound silence, it noticed something amiss. Distance voices were approaching across the plains:
Balochistan, with a gentle, aged voice: Lahore my child, Why haven't you been sparkling for a long time, I see...?
The winds carried the pause.
Lahore(laughs bitterly): Sparkle? That's a forgotten word to me... I'm immersed in the impure air, stars fell silent in me long ago, the moon!? Oh dear...
Balochistan**:** Wasn't it the one they searched for, on chaand raat (festive night of the moon).
Lahore**:** They used to adore the crescent in me, as if the sky itself was smiling down at them.
Balochistan**:** And now?
Lahore**:** They got their joy from artificial glitter, its glow made me hazy, and them: "almost blind".
The billboards are taller than trees, the air is too heavy to leave the lungs.
They don't look long enough to notice what's missing, some never look up at all.

I was once named Paris of the east. Now my rank in pollution has only increased.
Islamabad (sighs): I see the thread has begun? I'm scared if I'll lose my title of: "Breath taking capital".
Balochistan (concerned): I hope the "breath" isn't taken away.
Lahore**:** I'm afraid it's happening to you now, for the last five years, I've become a dust dome. I'm carrying layers no sky should bear alone.
Islamabad**:** Aren't they the same people who caused it all?
Lahore**:** Not all of them. And it's not just about the city beneath me – I'm being burdened with smoke drifting across the border. The sky knows no boundaries, and that's a curse to me.
Islamabad: You know my twin as they call it. Old bud exhales its industrial emissions; I'm the one inhaling it.. the lights, most of the time, are suffocating. Only in rare gaps do I get to breathe again. At times, it's choking me.
A pause ....are those trees my only saviour.?
Lahore (wistfully): Trees? I had those once. I even had Iqbal and Faiz writing poetry sitting beneath me. It's hard to believe now, but those very شاہین (Falcon) and ستارے (stars), Subh-e-Azadi (Dawn of Freedom) and Teeragi (Darkness) were the visionaries born of me.
My glow now hangs in a precarious balance.
I stand denuded of stars; choked with this murky air.
You only cry on light pollution, I'm trying hard to hold onto the treasures that once laid beneath, while light and smog cling to me like a second skin.

Tell Balochistan – you have seen centuries pass, will I reclaim the stars?
Balochistan**:** Hope is a stubborn thing; it rises when you cling to it, that's why I seek darkness; not in fate, but deep enough for wisdom to shine like stars.
Lahore**:** My hopes are now buried deeply underground. Will they ever rise again, or be lost... forever?
Karachi joins in
Karachi(in a sad voice): You are not alone, my dear friend, it's the same for me .
Lahore**:** But what happened to you? You used to speak, tell the stories of everything you had in your core .
Karachi (in a giving up voice): They have forgotten to listen to it now, or maybe they are too busy now, in calling me the city of lights. Beneath me life runs, while I struggle to catch a single breath.

The winds stretched far, bringing clarity from the north

KPK**:** They used to write poetry about us all. What happened to that now?
Lahore**:** Now they are only about their loved ones and their own struggles.

KPK**:** The land beneath me is Skyland for a reason, I'm like a hanging ocean above; yet watching it turn red with the innocents' blood.
Parachinar**:** They used to name stars after their lovers, remember?
Karachi(sad laugh) : Yeah..Now they only name malls and parks .
Islamabad**:** I hear children ask their parents what that "bright thing" is, not knowing it's just a plane.
Karachi**:** My sea used to reflect constellations, used to reflect the glittering stars like a diamond. And now it feels like somebody stole that "glittering diamond".
Lahore**:** They buried the stars beneath glass and concrete...and no one came to mourn. I miss the River Ravi running beneath, carrying the reflection of the stars above.
Karachi**:** Do you know what it is to burn above them – and still be unseen?

Their lights swallow the shore.
Even the sea forgets the stars.

Lahore (staring at Balochistan) :Why have your words fled into the night?
Balochistan**:** Nothing, dear, I was just worried about my future. All these things now flash in my memory, and what I just imagined is terrible.
Karachi**:** Don't worry, Balochistan, I hope people will understand soon and stop doing all of this. As for me, I'm already in deep water.
Islamabad**:** But aren't you far above?
Karachi**:** Seriously?
Balochistan**:** Cease!
Hyderabad**:** They won't move. Remember? When they looked away while I watched myself crumble.
Balochistan**:** I had the shiniest wheels, now they're rusting. Look at Quetta, called "the little London".
Karachi**:** Then speak louder. Make them see what they're about to lose. Maybe they'll listen to you, the one who still has stars.
Gilgit-Baltistan**:** He's right, Balochistan! You must fight..I have someone who can guide you.

Balochistan**:** Who is that SOMEONE ?

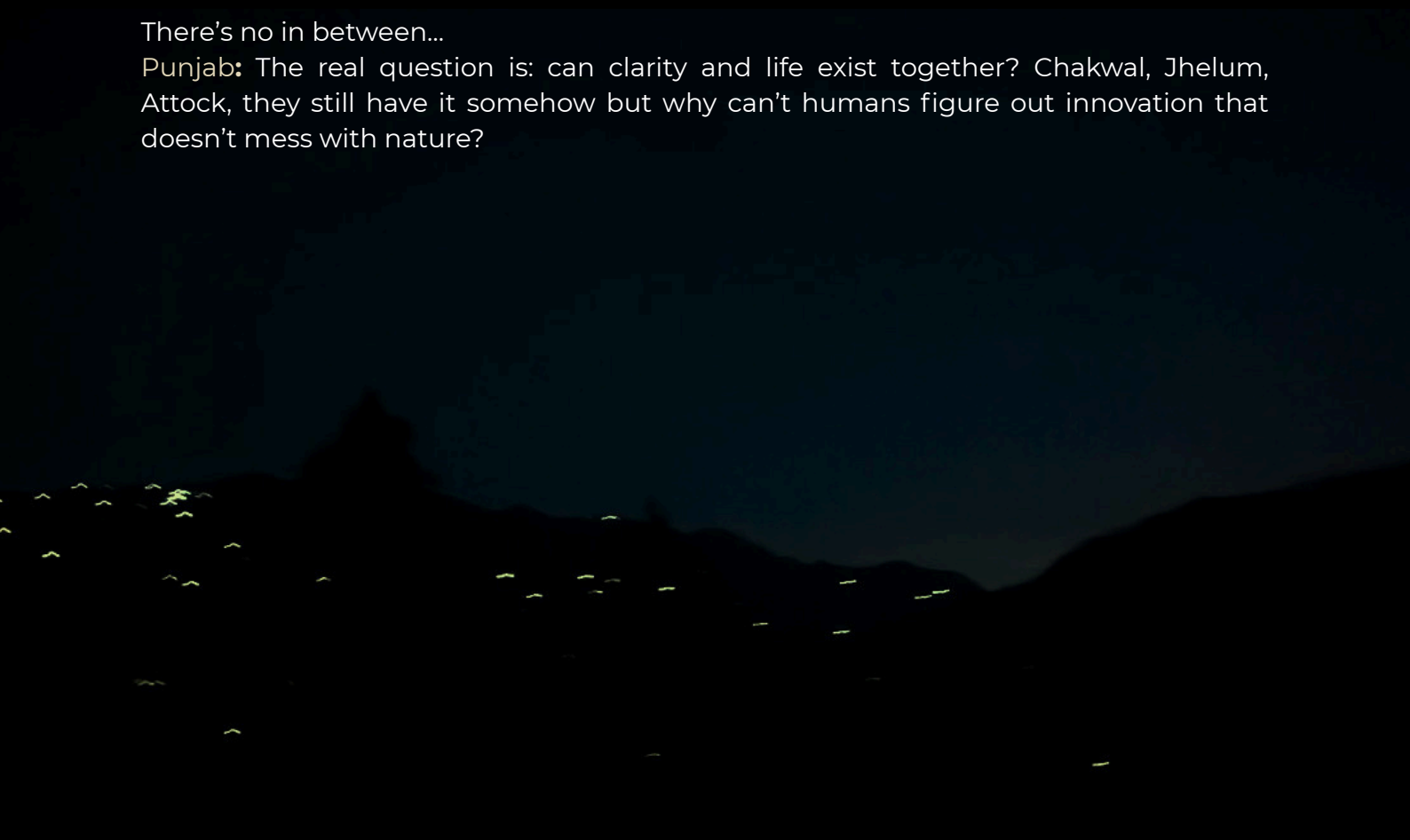
Skardu walks in with heavy steps!

Skardu**:** I heard I was called. I'm here.
Islamabad: Skardu. Glad you made it!

Skardu**:** I was just busy covering up the godforsaken mess that they made in me ..and I'm still not done.
Lahore**:** Skardu, tell Balochistan your story. He is the next target for them.
Skardu**:** I'm so sorry for you all. And Balochistan don't worry, we're all with you.
Balochistan**:** I know. But I'm so scared. What if people can't even see the galaxies and stars, and constellations in the future?

Islamabad**:** My people can't even see stars perfectly, and you're worried about galaxies and constellations?
Balochistan**:** That's what I'm known for. I fear the day the children will ask about the stars, when their grandparents tell them the stories of how stars used to show people their paths, how they used to guide mariners in their greatest voyages, how kids used to show their friends, " OH, look, that's a scorpion in the sky". I fear that day.
My darkness will mean nothing if light takes over it.
Islamabad**:** But aren't humans natural beings too? Why can't they live in peace with nature, without being harmful? Why do they make clarity elusive and perfection unrealistic?
Skardu**:** Because they call themselves Intelligent.
Lahore**:**
So is this intelligence; their progress?
Is this what makes them "superior"?
Is it what they do; wherever they settle, something has to move, even the sky itself, drowning it in light?
Trading constellations for trivial glitter. And I began to realise it was never just me.
Karachi:
They'll see, they will understand, and they slowly are.
The heat traps, and the air that won't clear
Everything unfolds in front of their eyes,
now they realise that the ones who they called dramatic...weren't wrong.
Islamabad**:** This is it! Isolation might be the answer. Maybe stepping back, and separating from urban rush, is the only way left to preserve clarity.
Balochistan**:** Isolation without support won't protect you – it will disconnect.
A surfeit of anything isn't good. In this rush to modernize; areas like Lasbela and Gwadar, most of Sindh were never prioritized.
And others become experiments; look at Lahore and Karachi.

There's no in between...
Punjab**:** The real question is: can clarity and life exist together? Chakwal, Jhelum, Attock, they still have it somehow but why can't humans figure out innovation that doesn't mess with nature?



Baltistan (in an anxious shallow voice): I wonder if you ever heard the earth fall completely silent?
Urban Punjab: We haven't felt genuine stillness in years.
Even in the dead of night, machines hum, and somewhere, sirens rise.
In war zones, silence follows explosions; not peace.
In cities, silence only comes during load shedding and even then, generators rattle in dark.
People are so used to artificial life now, that they don't know what to do when the lights go off, when the internet drops; when no screen glows in front of them.
They mistake noise for life, and silence for failure.
The winds carried a pause....
Gilgit**:** "So the Earth...
Does it only silence itself in spaces where we've abandoned it?
Or where we were never loud enough to begin with?"

Balochistan**:** *Let us not lose hope and strive for our rights to an unbroken night, which shuts up every other living being; where only faint susurrus could be heard. A night where streetlight bows to starlight, whose darkness neither frightens them outside nor its fake light locks them inside, where Orion would stride overhead each night as it should, and the moon full from a day of sunlight, cools it with its light.*

"Do not let your difficulties make you anxious—after all, it is only in the darkest nights that stars shine more brightly."
Maybe someone would listen?
The winds stalled again..
Islamabad**:** But how're we gonna do that?
Balochistan (Smiled hopefully)
And then all the skies stood as one. High above where the blue deepens into eternal dark rests the sky's memory, the captured hushed voices of wise men from the past. The world beneath felt silent, a terrifying quiet paused every heartbeat. The sky bruised into a color no dawn could forgive. The mingling winds settled making the silence profound. They were hoping that people down would listen to others' words to make a change, or else they would have to choose their bitter fate.
Sky earth distance compressed. Some human voices started to emanate from the fading sky's memory as two men talked to each other:

They (humans) can't live without nature, yet they meddle with it and destroy it, being completely deaf to the beating of nature's heart. The most important things for human beings are clean air and clean water, and the trees and grass that produce them. But folks pollute everything, and it's lost forever.
You don't have electricity?
We don't need stuff like that.
People are suckers for convenience...they think the more convenient, the better.
Isn't it dark at night??
"Night is supposed to be dark". We would be in trouble if night were as bright as day.
I don't want a night so bright; I can't see the stars.

Acknowledgements
"The very opening exchanges and the final reflective dialogues on humans and nature were adapted from Shark Tale (2004) and Akira Kurosawa's Dreams (1990)."

See the tiniest star in the night sky tonight? It's the light traveling for millions of years before reaching your eyes. That's the power of nature. Yet the brightest light we make at night is entirely our own, successfully obscuring our sight to stars. Use it wisely, and help keep the natural rhythm alive. You can be part of this effort by joining Dark Sky Pakistan or Dark Sky International, working to preserve the clarity of Pakistan's skies and the night skies of the world. Stars wait to be seen.

Izza and Zaid

The members of the DarkSky International, currently in the final and sophomore years of Bachelor's of Space Science at IST, respectively, are among the few in Pakistan actively working to confront the rising threats of light and air pollution. Alongside their academic pursuits, they take initiative through both written advocacy and on-ground efforts to address these growing environmental challenges.

SEA YOU ABOVE

Effects Of Artificial Light On Marine Life

by ZAID ALI HYDER

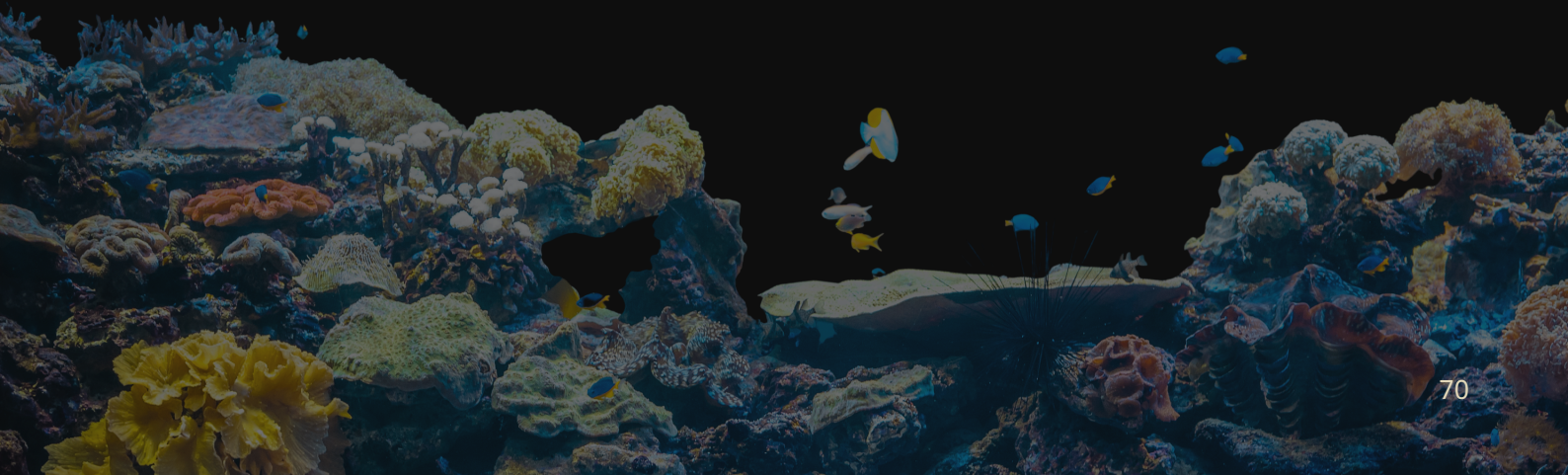
Sea turtle conservation | DarkSky International

Where there is light, there is life. They say that there is a glow of life because there's a spark of light. But sometimes the essence of existence can also be the kindled flames that swallow it. Artificial Light at Night, also known as ALAN, is the human-made lighting that illuminates the environment when it's dark. It is different from the natural light as it is continuous and often different in spectrum and could have many effects on the environment. The ocean that once obeyed the moon's soft pull and the waves that once danced beneath its silver shine, are now confused by the artificial stars surrounded by them. Even though artificial light is very helpful, it affects life in many ways.

The lights that brighten the coastlines also have impacts on marine life.

As for the effects of artificial light on marine life, sea turtles are the ones in the front line. Female sea turtles find the open sea and move towards it, but due to the artificial lights, they get distracted and move the other way, leading to the increase of chances of getting caught by predators. Artificial lights also attract small fishes and other little organisms which is risky as it also attracts their predators. It seems like little phenomenon, but with long time, it can affect the population and growth of these species.

Artificial light also affects other species of fish. In a research study published by Eureka Alert, it was shown that the baby clown fishes raised near the shore under the artificial light had 44% lower survival rates than those raised farther in the sea, away from the artificial light.



The artificial lights also impacts the natural dark and light cycle that many species follow for eating, growing and mating. For example, the corals release their gametes into the ocean based on the cycle of light of the moon. However, the artificial lights mostly outshine the moonlight cycle and could trick the corals to release the gametes at times that are not appropriate for fertilization. This can affect the population and sustainability of the corals.
Zooplankton species form a part of marine food webs, providing nutrition to a large number of species.

However, they are highly sensitive to **artificial light;** driven by this **man-made brightness,** they migrate into the deep ocean, severely impacting ecosystems near illuminated areas.

Besides these, artificial lights have effects on many other marine species as well as other wild life like birds. The impact is increasing day by day as the cycle of nature is being invaded.

Nature gave us day and night cycles for a reason, but the disruption due to human activities can lead to serious consequences. Of course, artificial lights are highly beneficial in many ways and serve our needs, but this illumination should be limited. Currently, we're only focusing on how it's helping us rather than also considering the negative impacts.
But falling feels like flying till the bone-crush, so before we experience severe repercussions, we should take several actions, like building a barrier at the shores to separate the sea from the city's light pollution, turning off the lights at the shores when they're not needed, using automated lights that can switch off when not in use, and many others.

This is our planet and if life of any kind is being affected because of us, we should save it instead of pursuing our superficial economic benefits.

The world is ours, and we have to look after it.

ZAID ALI HYDER

Zaid is a Space Science undergraduate at the Institute of Space Technology (IST), Pakistan. Captivated by the grandeur of the cosmos, he is particularly interested in astronomy, astrophysics, and planetary science. He is fascinated by the stories written across the vastness of the universe. Through the glints of the celestial tapestry, he hopes to trace the depths of its enduring mysteries.

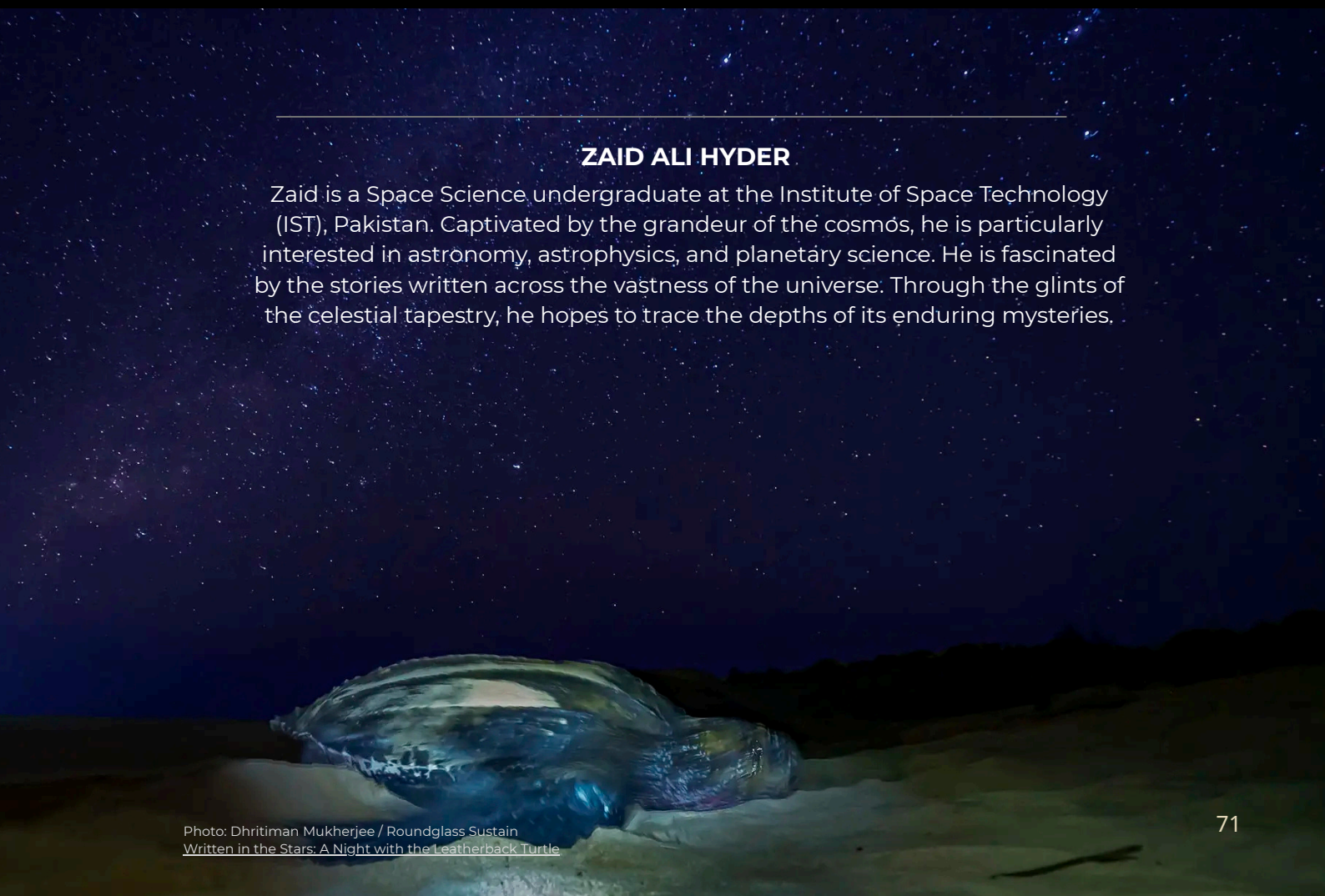


Photo: Dhritiman Mukherjee / Roundglass Sustain
Written in the Stars: A Night with the Leatherback Turtle

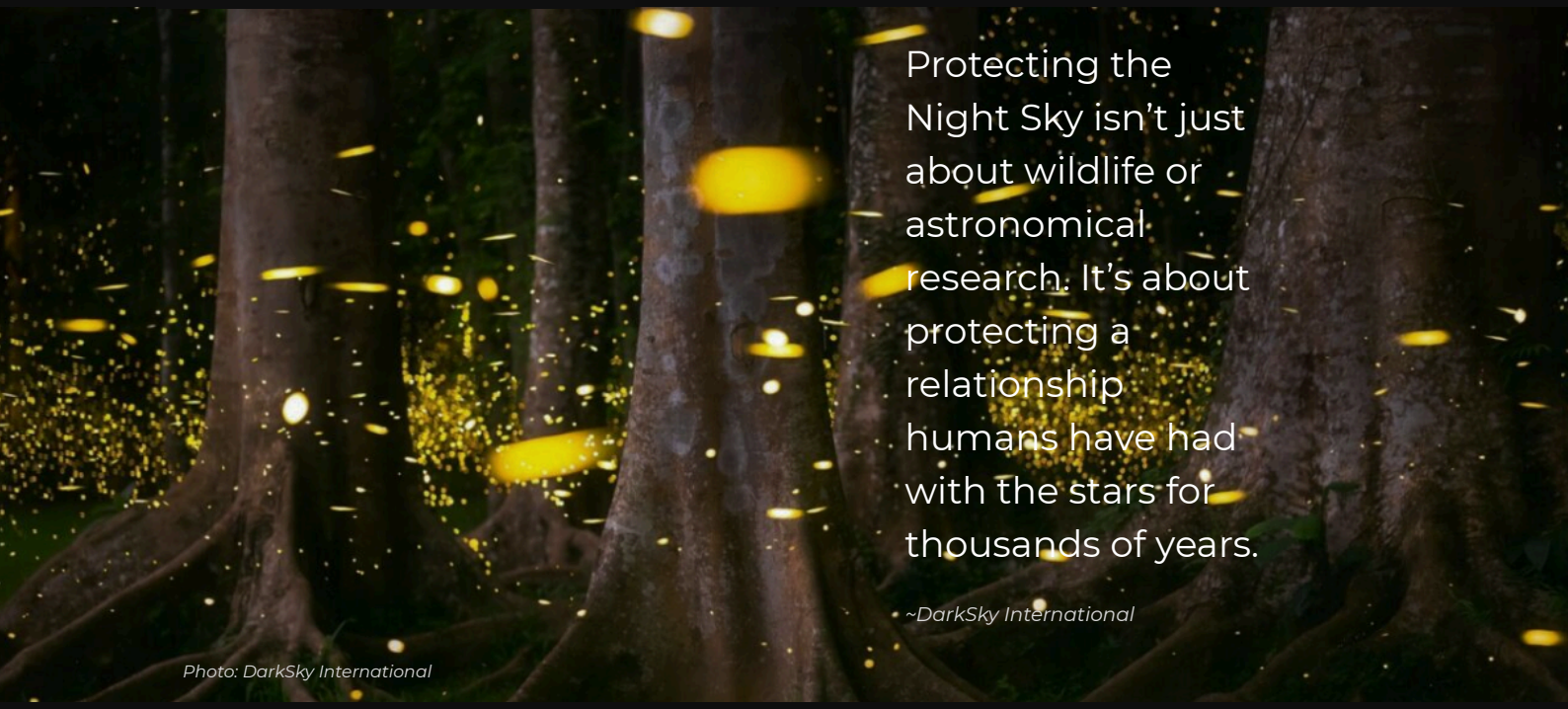

Protecting the Night Sky isn't just about wildlife or astronomical research. It's about protecting a relationship humans have had with the stars for thousands of years.
~DarkSky International

Photo: DarkSky International

Dark Sky International is a global organization dedicated to preserving the natural beauty of night skies, raising awareness about light pollution, and promoting responsible lighting practices around the world. In Pakistan, this mission is championed by the **Dark Sky Pakistan Chapter**, a passionate community of volunteers, educators, astronomers, and environmental advocates working together to protect the country's rapidly diminishing dark skies. The chapter highlights the cultural, scientific, and ecological importance of natural darkness, from supporting astronomy and wildlife to sustaining human well-being.

By joining this volunteer network, individuals can contribute to community outreach, awareness campaigns, local dark-sky initiatives, and the promotion of sustainable lighting solutions. Becoming part of Dark Sky Pakistan means taking action to safeguard Pakistan's celestial heritage and ensuring that future generations can continue to enjoy the wonder of star-filled nights.

Words by: Rayan Khan, Chapter Leader
Contact: rayanstagram@gmail.com
Learn more at: https://darkskypakistan.org/

NEAR EARTH ASTEROIDS: EXPLORING IMPACT CONSEQUENCES AND MITIGATION STRATEGIES

by SANA SALIM

INTRODUCTION

Our solar system was formed about 4.5 billion years ago from a cloud of gas and dust. Numerous different celestial entities of various sizes were born in addition to the Sun. It is believed that among these tiny bodies, some of them became huge enough to be shaped into spheres by the gravitational force, developing into planets, dwarf planets, and large moons. However, a few of them did not grow big enough, and instead, these leftover pieces evolved to become comets, asteroids, and meteoroids.

These asteroids have made a place for themselves in the solar system known as the asteroid belt, which is located between the orbits of Mars and Jupiter. There are also asteroids in other regions of the solar system that are continuously evolving and regenerating, such as in the Trojan asteroid clouds and the near-Earth asteroid population (NASA Science, 2023).

They have huge masses and do not orbit in perfect circles, causing them to come near other planets. Their vast population mixed with the gravitational pull of these planets has caused them to cross their depicted boundaries and change orbits (Nasa Science, 2020).

The asteroids that come close to Earth are called Near-Earth Asteroids (NEA). If a large enough asteroid, of the order of 100 kilometers in diameter, were to impact the Earth, living conditions could become unsustainable, to the point of threatening all known species and even humanity with extinction (Chapman, C & Morrison, D, 1994). This is the reason why NEAs are also called PHOs (Potentially Hazardous Objects), because though NEA impacts are a rare event, even a small orbit disturbance can lead them to cross the Earth's orbit in a short amount of time. Reasons like this show how we are at a constant risk of human extinction, and more importance should be given to its research. If the impact is predicted long in advance, the object can be deflected, and the risks/effects can be mitigated.

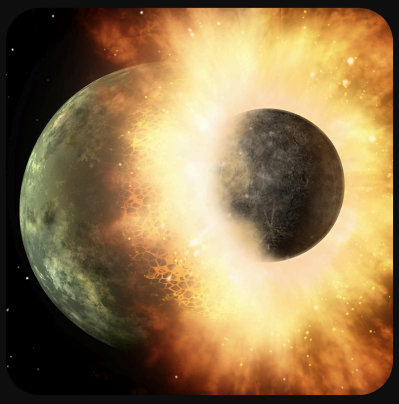
LITERATURE REVIEW
Impact Probabilities:

Over the past few decades, crater statistics have been the primary source of probabilities for NEO impacts. The method of crater counting is used to calculate how old a planetary surface is. It is predicated on the idea that the quantity of craters present on a surface is directly proportional to the duration of the surface's exposure to impacts from asteroids and other small bodies.

To count the craters on a given surface, scientists must first locate and count each one. The number of craters and the age of the surface are then connected using a mathematical model. This method is used by scientists to calculate how many craters would form on a specific surface over a given amount of time. This information is then utilized to calculate the probability of an asteroid's impact creating a crater of a certain size on that surface. The largest crater on Earth is the Vredefort crater, which is roughly around 2 billion years old (UNESCO World Heritage Centre, 2005).

NASA Earth Observatory image by Lauren Dauphin, using Landsat data from the U.S. Geological Survey.

This is proof that massive comets and asteroids have previously struck Earth in the form of the Vredefort impact structure. There would have been huge destruction and extinctions as a result of the collision, causing a global catastrophe. The probability of a similar impact likely happenning again is very low, but it is not zero. Scientists estimate that an impact of the size of the Vredefort impact is likely to occur every 100 million to 200 million years.



However, as it is not a perfect technique and has limitations, with time, crater counting is now mostly used for studying the history of planetary surfaces.

Today, NEO population models are available, which are based on observational data representing the actual NEO numbers. For example, the Sentry System is a system developed by NASA JPL (Jet Propulsion Laboratory) that uses data from the NEOWISE (Near-Earth Object Wide-field Infrared Survey Explorer) and other missions to identify NEOs that have a significant chance of impacting Earth. Apophis, an asteroid, was projected by the Sentry System in 2004 to have a 2.7% chance of hitting Earth in 2029.

Although more observations have subsequently ruled out the chance of an impact in 2029, Apophis, along with many others, is still a possible threat in the future (NASA Science, 2023).

Nevertheless, it is important to bear in mind that only a few percent of the NEOs have been detected up to now, and therefore, a sudden unpredictable impact or a very short warning time of a few days or weeks are the most probable scenarios. For evidence, the asteroid 2001 EC was found on March 3, 2001. Tracing its orbit's past trajectory revealed that, on February 26, 2001, it passed Earth at a very close distance (Minor Planet Center, 2001).

Consequences of Impacts:

Assuming a 10 km-sized asteroid hits Earth, even though a massive population would be in danger, there would still be safe havens for people to live (Chapman, C & Morrison, D, 1994). The first result, as per the model by (Collins G.S et al., 2005), would be a massive crater with a diameter of perhaps more than 1100 kilometers. A horrific fireball would radiate and burn practically everything up to 4800 kilometers from the impact in less than a minute. Massive destruction would also result from an incredible airburst far away from the impact. In the meantime, massive amounts of ejecta would rise to great heights and descend all over the Earth, destroying towns and forests and triggering earthquakes and tsunamis.

Let us then, for safe measures, presume that while all life would be killed in a few seconds within a few thousand kilometers from the impact site, some life forms located on the other side of the Earth would survive the immediate effects of the catastrophic event.

But several variables will soon make the situation far more challenging as global temperatures rise to several hundred degrees Celsius:

- The impact would cause melting in different places on Earth (Marinova M.M et al., 2011).
- There would be shooting stars and fires all around the globe (Toon O.B. et al., 1994).
- Giant volcanoes may appear all around the globe (Toon O.B et al., 1994).
- The planet would be quickly enveloped by about 100 bars of hot rock vapor (Sleep N.H et al., 1989).
- Part of the ocean would boil off, forming a layer of hot steam (Sleep N.H et al., 1989).

Mitigation Systems:

Over the past 15 years, numerous concepts for diverting and displacing potentially dangerous asteroids have been put forth (Gritzner Ch, 2001). The most common of them include kinetic impactors, which are spacecraft that would be used to collide with asteroids and deflect them off of a collision course with Earth (Dunham & Harris, 2016).

Another example is of the gravity tractors, spacecraft that would use their own gravity to deflect asteroids. Gravity tractors would be more complex and expensive than kinetic impactors, but they would be more effective at deflecting large asteroids (Barbee et al., 2007).

This all would be possible if the period of impact is known long before it happens, typically centuries prior.

However, with our lack of technology, we would not be able to predict ten years before the event that an NEA would definitely miss or impact the Earth. If we try to deflect a giant asteroid long before it passes close to Earth, even a small deflection of a few thousand kilometers may only slightly reduce the impact probability. It does not guarantee that the asteroid will miss Earth, and we may not know for several years whether the deflection actually increased the impact probability. Considering these factors and the uncertainties of the universe, the worst-case scenario will be that we won't have enough time before an asteroid is right above our heads. The mitigation ideas proposed are the last option to be used, that is to destroy it.

The most controversial one is the Nuclear deflection method. It involves setting off a nuclear weapon close to an asteroid in order to create a shockwave that would divert the asteroid.

It is risky and could create multiple problems, like breaking the NEO into smaller pieces, increasing the number of threats, or the release of radioactive material that would pose a hazard to human health and the environment. Not to mention that the likelihood of it being successful is very low.

CONCLUSION

In this article, we have concluded that asteroid impacts are a rare but serious threat to humanity. The consequences of a large asteroid impact can be catastrophic, causing global destruction and mass extinctions. Scientists are developing new methods to predict and mitigate asteroid impacts
However, our current technologies are limited, and we may not have enough time to deflect a giant asteroid if it is discovered too late.

Therefore, it is important to increase our awareness of the asteroid threat and to develop early warning systems and emergency response plans. The world needs to work together, and though, indeed, the impact probability can never be zero, international treaties and agreements should be made on how to deal with asteroid impacts.
More real-time tests should be conducted in advance, and an evacuation plan must be formed for the worst-case scenario where we need to abandon our humble abode.

By emphasizing our need for more research on this topic, we can improve our chances of surviving an asteroid catastrophe and ensuring the future of humanity.

RESEARCH QUESTIONS:

- What is the risk of the extinction of humanity by asteroid impact?
- When is the probability of impact from giant asteroids or comets?
- What are the recent mitigation or deflection strategies?
- Can we really save ourselves from this catastrophe?

Sana Salim

Sana Salim is pursuing a Bachelor's degree in Space Science at the Institute of Space Technology, Islamabad. She enjoys exploring topics such as Near-Earth Objects (NEOs) and their impact on the future of space exploration, and is passionate about astronomy and space exploration. Her academic journey is driven by the goal of advancing scientific knowledge and developing technologies for the next era of space exploration.

Dark But Not Dull:

A journey into dark matter

by SYEDA NAIMA

The birth of the idea of dark matter and its history

The entirety of the existence of this universe visible to the human eye, including the stars and the outer galaxies discovered to date, is only a little more than 15% of what exists. The rest 85% of the matter of this universe is, in fact, not visible to us, and that is what the astronomers refer to as “Dark matter”. This raises an intriguing question: how can we be certain of its existence if we can’t even see it?

In 1933, one prominent Swiss astronomer of the time, named Fritz Zwicky, shed light on the aforementioned idea. While closely observing the clusters of galaxies with the help of Hubble’s observations, Zwicky proposed how the fast speeds of these individual galaxies contradict the very idea of them staying in clusters because according to their relative speeds, they should have fled away from these clusters long ago as there’s not much proof of mass visible which may be keeping the galaxies intact together in the cluster.

Hence, Zwicky put forward his idea of there being some sort of unseen dark matter, describing it as "dunkle Materie" because of which the galaxies were held together. Unfortunately, what he said was not given much thought till the 1970s.

In the 1970s, this idea came to the forefront once again when an American female astronomer, Vera Rubin, put forward the possibility of this dark matter being present inside individual galaxies.

At first, Rubin’s idea was met with skepticism for a few reasons. The concept of Dark Matter, though not entirely new, remained controversial and lacked widespread acceptance. Although Rubin’s work provided enough evidence, the notion of unseen mass was still hard for many to accept without further corroboration

Keeping in mind how, at the time of her research in the 1970s, observational astronomy was less advanced, many astronomers were cautious about accepting results which could be perceived as errors due to observational limitations.

Adding the fact that she was a female in the industry, gender bias played a major part in causing hindrance for her, too. Despite the hurdles in the journey, Rubin's observational data gradually gained acceptance, and today she is known as the "Pioneer of Dark Matter."

"We now know that the dominant contribution to the mass of the universe is not what we can see, but what we cannot see." -Vera Rubin

Diving deep into Dark Matter:

To understand Dark Matter, we first need to have a thorough idea of how the gravity in our solar system works. The maximum mass of our solar system is in the sun. All the planets orbiting the sun are, in fact, much smaller than the sun.

According to NASA, the Sun has a diameter of about 1.39 million kilometers, which is approximately 109 times the diameter of Earth. When comparing the Sun to Jupiter, the largest planet, the Sun's diameter is about 10 times larger. Since Jupiter's diameter is about 11 times that of Earth's, this makes the Sun roughly 1,000 times the volume of Jupiter.

The other planets are significantly smaller than Jupiter, making the Sun thousands of times larger in volume compared to each of them.
(Source: NASA Solar System Exploration)

Newton and Kepler's theories about orbits educate us on how, once a planet starts moving farther away from the sun, the relative speed by which it orbits the sun starts to decrease gradually.
Talking more numerically, this was the formula of escape velocities used to calculate the speeds of the planets moving:

$$v_{esc} = \sqrt{(2GM/r)}$$

Where v_{esc} is the escape velocity, G is the gravitational constant (6.674×10^{-11} m^3 kg^{-1} s^{-2})
M is the mass of the celestial body, and r is the radius from the center of the celestial body to the point of escape.

Based on what we observe in our solar system, we tend to expect the same phenomenon to take place in our galaxy as well, but that's where things take an interesting turn.

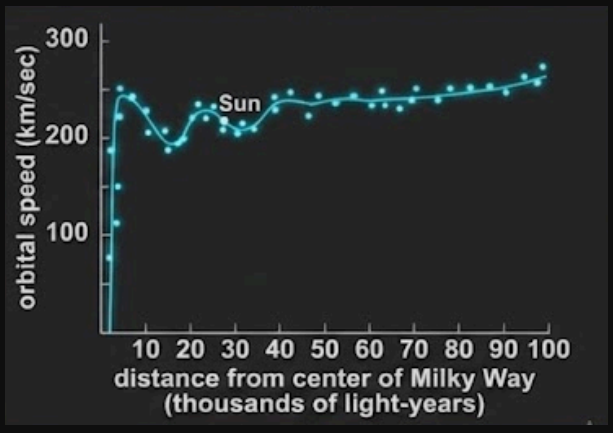
Our very own Milky Way galaxy consists of many stars in its galactic center, where most of the visible mass is located, and if we keep moving away from it, the very speed at which the stars are orbiting around the center of the galaxy should technically decrease.

The astronomers pondered over this idea and further investigated it from a larger distance. They made observations of the orbiting speeds of some rather lonely stars and gas clouds on the outskirts of the galaxy, thousands of light years away from the center of the Milky Way galaxy, and to their surprise, these celestial bodies were pacing with speeds as high as 200 kilometers per second.

This observation clearly defied the previously presented theories of the speed of a celestial object decreasing upon increase in distance from the maximum mass at the center for the case of a galaxy.

Consequently, the one assumption made by the astronomers was that this phenomenon may be the result of the distant stars in the galaxy rapidly orbiting some matter which is concealed from us.

The astronomers had developed the concept of rotation curves to understand the dynamics of galaxies, particularly their rotation speeds at various distances from the center. They plotted the investigated data and noticed that the speed of the stars does not diminish at the outskirts of the Galaxy - the rotation curve is flat showing uniformity in speeds even at such a large difference between distances. They became sure of the existence of some other matter accountable for the fast moving distant celestial objects. That became the key evidence of Dark Matter.



Astronomers have determined that approximately 85-90% of the Milky Way's mass consists of dark matter. This estimation is based on observations and studies of the galaxy's rotation curve. One detailed study found that the total mass of the Milky Way is about 1.5 trillion times that of our Sun, with dark matter contributing to the vast majority of this collective mass.
(Source: Astronomy Magazine)

This finding aligns with observations that suggest about 90% of the galaxy's mass is dark matter, leaving only about 10% attributed to stars, gas, and other visible components (National Radio Astronomy Observatory).

What is Dark Matter REALLY: its composition

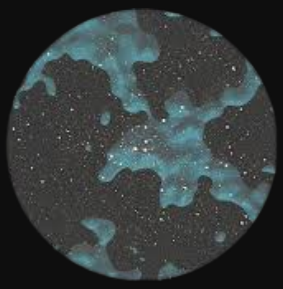
The honest answer to this question:
we are unaware of what dark matter truly is as of today. It remains one of the biggest unresolved mysteries in the spectrum of astronomy.

These conclusions were drawn from multiple studies, including analyses of satellite galaxies' orbits and simulations comparing the Milky Way to similar galaxies in the universe

We are only certain of the fact that dark matter is something that's not visible to us. One possibility arises that it's either particles, comets, or even asteroids in huge numbers around our galaxy in a halo, but their existence is faint, making them invisible to human eyes.

However, if this were to be true, they could have still been detected under Infrared light, and they unfortunately aren't. Another possibility may have been that this dark matter is actually a bunch of black holes.

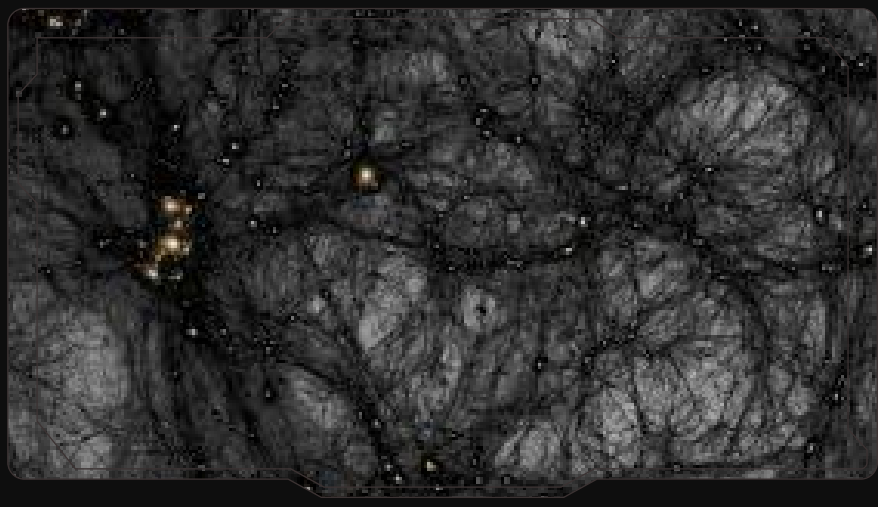
Astronomers in theoretical predictions have referred to this matter as WIMP (Weakly Interacting Massive Particles). Searches for these particles and their origin are being conducted in different regions of the world. The experiment "DM-Ice" in Antarctica was initiated to look for these particles using a neutrino detector. A neutrino detector might come off as a rather odd way of looking for dark matter, but the physics behind it makes it a rational approach.



The reason is that the distribution of dark matter in the halo is known to be quite smooth. The one thing we are certain of is that this matter doesn't interact with light: neither does it emit nor absorb any light. It only has an impact with gravity.

When traveling through large clumps of "standard model" matter (i.e., what we think of as "normal" particles), WIMPS could lose energy and eventually become gravitationally bound to the body they are traveling through. This would be the case with planets, or with the Sun. So the center of the Earth could harbor a large, unseen mass of weakly interacting particles.

Directly detecting a cluster of WIMPs is virtually impossible. However, scientists could determine their presence by observing indirect indicators—neutrinos. These ever-moving particles, which are quite hard to detect themselves, are predicted by theories suggesting that WIMPs wipe out of existence upon interacting with standard particles. Given their elusive nature, the neutrinos produced from such interactions within a WIMP concentration at the Earth's core would likely escape through the Earth and eventually into space. However, unfortunately, there has been no detection of these particles yet. Hence, the search for WIMPS continues.



A simulation of the formation of dark matter structures from the early universe until today.
Ralf Kaehler/SLAC National Accelerator Laboratory, American Museum of Natural History

Syeda Naima Rizvi

Syeda Naima Rizvi is a space science student whose curiosity about the cosmos inspired her independent research on dark matter. She was the first to design and singlehandedly lead the astronomy module of her high school's science olympiad, creating Celestra, a fictional planet with a fascinating atmosphere, and telescope-building challenges that participants loved. Known for blending scientific inquiry with creativity, she also founded HijabistanPK, an eco-conscious hijab brand. Her journey reflects leadership, imagination, and a passion for making both science and society brighter.

Halo: The Fall of Reach

by RAYYAN SAGHEER

Halo: The Fall of Reach

This is a military science fiction novel by Eric Nylund, set in the Halo universe, and acts as a prelude to Halo: Combat Evolved, the first game in the series. The book was released in October 2001 and is the first Halo novel.

The Halo universe is a vast sci-fi mythology spanning ancient civilizations, lost histories, and the struggle for survival. Central to its lore is the Mantle of Responsibility—a sacred duty to protect all life—originally granted to humanity by the Precursors, Lovecraftian-esque godlike beings whose neural physics-based technology allowed them to manipulate time and space, shape evolution itself, and traverse the galaxy. The Forerunners, believing that their creators had turned against them, rebelled and concocted a galactic genocide of the species, eventually bringing them to extinction and unknowingly creating the Flood—a parasitic entity formed from the Precursors' corrupted remains.

The Flood spreads by infecting sentient beings, turning intelligence into a weapon. Millennia ago, ancient humans developed advanced space travel and waged a desperate war against the Flood, pushing deep into Forerunner space. The Forerunners, in turn, also launched a war against humanity, defeating and forcibly devolving them back to a primitive, Stone Age state.

Later on, as the forerunners themselves fought against the flood, they were unable to keep the monstrosity at bay. As the Flood consumed much of the galaxy, the Forerunners activated the Halo Arrays, massive ringworlds designed to exterminate all sentient life to starve the Flood. With their civilization gone, the galaxy lay dormant until modern humanity.

The plot of the book follows humanity's resurgence as a galactic power in the 26th century, which has expanded across multiple star systems, inevitably bringing them into a devastating war with the Covenant, a powerful alliance of alien species that sees humans as an offense to their religion. As the Covenant begins wiping out humanity's planetary colonies one by one, Earth's survival hangs by a thread. The Covenant doesn't seek negotiation or conquest; it aims to erase humanity. This conundrum, where humans fight for survival and the Covenant fights for belief, gives the war a tragic inevitability.

The United Nations Space Command (UNSC), though advanced by Earth standards, is critically outmatched in both space and ground combat. The Fall of Reach is a turning point in this conflict. Reach isn't just a military hub; it's Earth's last major stronghold and the heart of Spartan operations. Its fall symbolizes the vulnerability of humanity's best defenses.

Strategically, losing Reach meant losing access to the majority of the UNSC's galactic fleet and infrastructure, leaving Earth exposed. Emotionally, it shatters any illusion of safety, marking a moment of collective desperation. Halo: The Fall of Reach tells the emotional and intense story of how humanity prepared for this threat before they even knew it existed. Dr. Catherine Halsey, a brilliant but morally conflicted scientist, created the SPARTAN-II program by abducting and enhancing children to become super-soldiers. Among them was John-117, later known as Master Chief.

As John-117 rises to lead the Spartans, the Covenant emerges as a genocidal alien threat, forcing humanity to rely on the very Spartans once built for internal conflict. The story, culminating in the desperate defense of the planet Reach, which was one of the last of the inner colonies, highlights the desperate situation of all humanity was on the precipice of extinction. The Spartans and human forces fight to their last against overwhelming Covenant forces, and though Reach falls, the sacrifice paves the way for Master Chief's escape and the events of the Halo: Combat Evolved game, setting the stage for humanity's last stand.

Halo: The Fall of Reach left a deep impression on me; it was emotional, awe-inspiring, and undeniably cool. What struck me most was how it blended raw human emotion with epic sci-fi scale. In the midst of the war's staggering scope, where entire worlds fall and hope can feel rare, the Fall of Reach stood out to me as both deeply moving and exhilarating.

Reading it during a time when every UNSC broadcast reminds us how fragile our survival is, I was struck by how the novel humanizes the conflict: the Spartans' stolen childhoods, their steadfast camaraderie, and the harrowing defense of Reach make the galaxy-spanning war feel intensely viscerally personal.

The Halo mythology has left a profound impact upon me, proving to sow the seed for my interest in the Final Frontier as well as everything which lay dwelling therein, so much so that certain life choices, including my career, were heavily influenced by the persona and magnitude of the cosmos, as well as the infinitesimal amount of possibilities of technological ingenuity and marvel which came with it.

A Kaleidoscope of the World

ستاروں سے آگے جہاں
اور بھی ہیں

Beyond the stars are even more worlds…

ابھی عشق کے امتحان اور بھی
ہیں

There are still even more tests of passion…

by IZZA FATIMA HASSAN

These immortal words from Allama Iqbal evoke meanings far beyond poetry. They challenge us to look beyond our perception and question what we choose to see. But how do we see these "other worlds"?

Do you remember looking through a kaleidoscope as a child? With each tiny rotation from our fingers, the internal beads or colored fragments shift, revealing a new color, or a new pattern; one slight turn, and a better reality in view!

Perspectives are the kaleidoscopes of the mind. They're shaped by our shared struggles and our unique experiences. A rainstorm is a curse to the commuter, salvation to the farmer and poetry for an observer. Iqbal urges us to look beyond the obvious: "there are worlds unseen and challenges unmet".

This is the heart of Jahan Aur Bhi Hain-Beyond the Blue, Pakistan's first space-climate telefilm.

When you watch the night sky, the longer you stay, the more your eyes adjust to the darkness and stars you hadn't noticed begin to reveal themselves. Likewise, my first impressions of the film were raw. Both warm and cool cinematography clashing, like storms against quiet disputes. Only upon a closer look did its depth emerge.

Speaking with producer Dr. Najam I asked what drove the decision behind the Iqbal-inspired title.

His brilliant explanation immediately unveiled the film's deeper conceptual path, connecting the poetic inspiration to its cinematic evolution and narrative direction, that is **"Perspectives In Crisis".**

The film revolves around a woman's journey as a climate scientist. The play of perspectives is seen when she leaves home years earlier to pursue her dream, only to return to save her people facing an escalating disaster.

She faces the strong skepticism of authorities, some of whom would rather follow policy than heed the urgent catastrophic calls.

The narrative presents conflicting viewpoints: a few stand with her believing their astute observations, while most resist her warnings and challenge her plans. Beneath all these visible conflicts, things get a different end when she dares to look and act differently. What appears first to be a story about a disaster gradually reveals itself as a story about societal norms and human nature under adversity..

From the very start, the film enmeshed the viewer in suspense, the director making use of the best medium to connect with the general public. It's a perfect work of art that lets the audience experience the sharpness of perspectives, while seamlessly encapsulating science, technical nuance, behavioral depth, and sensitivity of human relations, all within a span of 36 minutes. By fusing science and cinema so brilliantly, the film affects beyond surface consciousness and becomes required viewing in Pakistan's climate conversation. Ultimately, it reminds us that progress demands agreed perspectives.

We often see the world through a single window, but Jahan Aur Bhi Hain reminds us that reality is actually a kaleidoscope–a shifting, brilliant pattern of perspectives that changes the moment we dare to look at it differently.

> **Basically this was an experiment of the Academia industry project. It's a combination of the beacon house National University and the Lock Down Production, and then from (NCGSA) IST we worked all together for the story line. In this film there was nothing that's out of science.**
> ~Dr. Najam Abbas at the Black Hole Islamabad, Film screening.

"**Women are the first to respond to such disasters**", said a speaker at the NDMA's DEWTE.

The film implies this through the arc of Amna Ilyas as Dr. Zainab. Her perseverance and analytical lens change not just her world, but everyone's.

In Pakistan, awareness of the unknown, delivered in familiar language is rare and action – even rarer. Yet the space-themed film, fusing science with our national poet Hazrat Iqbal's words, urges us to discover our full potential, to go beyond and to take initiative. But is such awareness enough?

Did we succeed in uniting against the odds, and saving ourselves from the unseen yet predictable, or **are there greater tests to come?**

Izza Fatima Hassan

Is a final year space science student at IST, majorly focused on studying space systems, with a keen interest in cartography. Outside academics, she turns to photography and journaling. She strongly believes that great art speaks to both imagination and soul—and that art, whether in films, writing, or photography, can be cherished beyond a lifetime.

Flooding Thoughts

by MAHNOOR IJAZ

The year 2025 put Pakistan to another test. Floods and sudden bursts of heavy rain swept through the country, impacting lives and livelihoods. It was a stark reminder of our vulnerability to extreme weather. This monsoon was not just heavy; it was harsh. It was one of the worst in decades, affecting multiple provinces since the monsoon started on June 26, 2025. The rain arrived early, lasted longer, and fell more intensely, rushing from the northern peaks to the southern plains.

The north faced even more devastation. Gilgit-Baltistan and Khyber Pakhtunkhwa experienced flash floods due to cloudbursts, melting glaciers, and unseasonably warm weather.

In Hunza, Ghizer, and Skardu, rivers roared with wild force. Floodwaters ripped through areas, destroying homes, roads, and bridges, burying entire villages and towns. Communities were cut off for days without food, electricity, or any way to ask for help. What we once saw as natural disasters and familiar landmarks lost their significance. "We are losing our ice, and the rest of the climate is slipping right behind it.

Khyber Pakhtunkhwa saw a dire situation as well. Districts like Swat, Chitral, and Buner faced such intense cloudbursts that they recorded hundreds of millimeters of rain in just a few hours. The loss of life in Buner was particularly tragic.

Landslides buried homes, flash floods washed over streets, and families fled uphill, helplessly watching as their possessions were submerged. When roads disappeared and bridges fell, the swift floods kept rescue teams from reaching the injured and missing. These floods struck without warning, leaving sudden harsh scars on our memories.

To the south, Punjab dealt with a slower but equally brutal disaster. Heavy rain and water flow from the north overwhelmed the Sutlej, Ravi, and Chenab rivers, flooding their banks. Villages disappeared under water. Fields that once thrived with green crops were mired in muddy water.

Countless farmers lost months of work in just a few hours—their harvests gone, savings washed away, and hope drowned. The cities suffered too. In Faisalabad, Sialkot, Lahore, and Multan, streets turned into rivers. Cars floated, as did children at play. Families waded through chest-deep water searching for dry land. Drains overflowed, power failed, and daily life came to a halt.

The floods of 2025 not only destroyed land; they showed how fragile our lives have become in a changing climate and how unprepared our cities are for storms that now come every year instead of every few decades.

Then came Sindh, where the Indus carried the floods into the plains. Districts such as Dadu, Khairpur, and Sukkur suffered again with little to no early warning. The human cost was significant in lost livelihoods too. Fields that were feeding families remained submerged for weeks, and crops rotting beneath the surface. With homes gone and livelihoods destroyed, the impact was devastating.

People fled to roadside camps, holding their children and whatever few belongings they could save, maybe a soaked blanket, a photograph, or a small bag of clothes. For hundreds or thousands of families, the exact loss remains uncertain. Rows of temporary shelters along the highways became their only option because they had nowhere else to go.

By the time the rains eased, thousands had died, officially reported as over 900 by early September 2025. Millions had nowhere to go, with damaged houses affecting many people, and over 2 million evacuated by early September. Billions of dollars in infrastructure were destroyed in an instant. The loss of human life and the destruction were significant, and this will not be the last time we face such challenges. A warmer atmosphere means heavier rain, and faster glacier melting leads to more severe floods. Mountains and plains are now interconnected in sorrow; what happens in the north no longer stays there. It flows down, and nothing can stop it

The skies opened in Hyderabad and Karachi as well, and the streets turned into rivers since there was no place for the water to go. Entire neighborhoods were submerged in waist-deep floods, houses filled with murky water, and traffic came to a halt. The low-lying, flat plains of Sindh left the water with nowhere to drain. Weeks passed, and an unexpected flood developed into a long-lasting, draining crisis.

The disaster of 2025 made one thing clear: Pakistan can no longer afford to wait. We need stronger early warning systems, better river monitoring, proper flood zoning, and effective drainage systems. We need reforestation, planning, and policies based on science rather than reaction. The next monsoons will come, and when it does, it shouldn't catch us off guard.

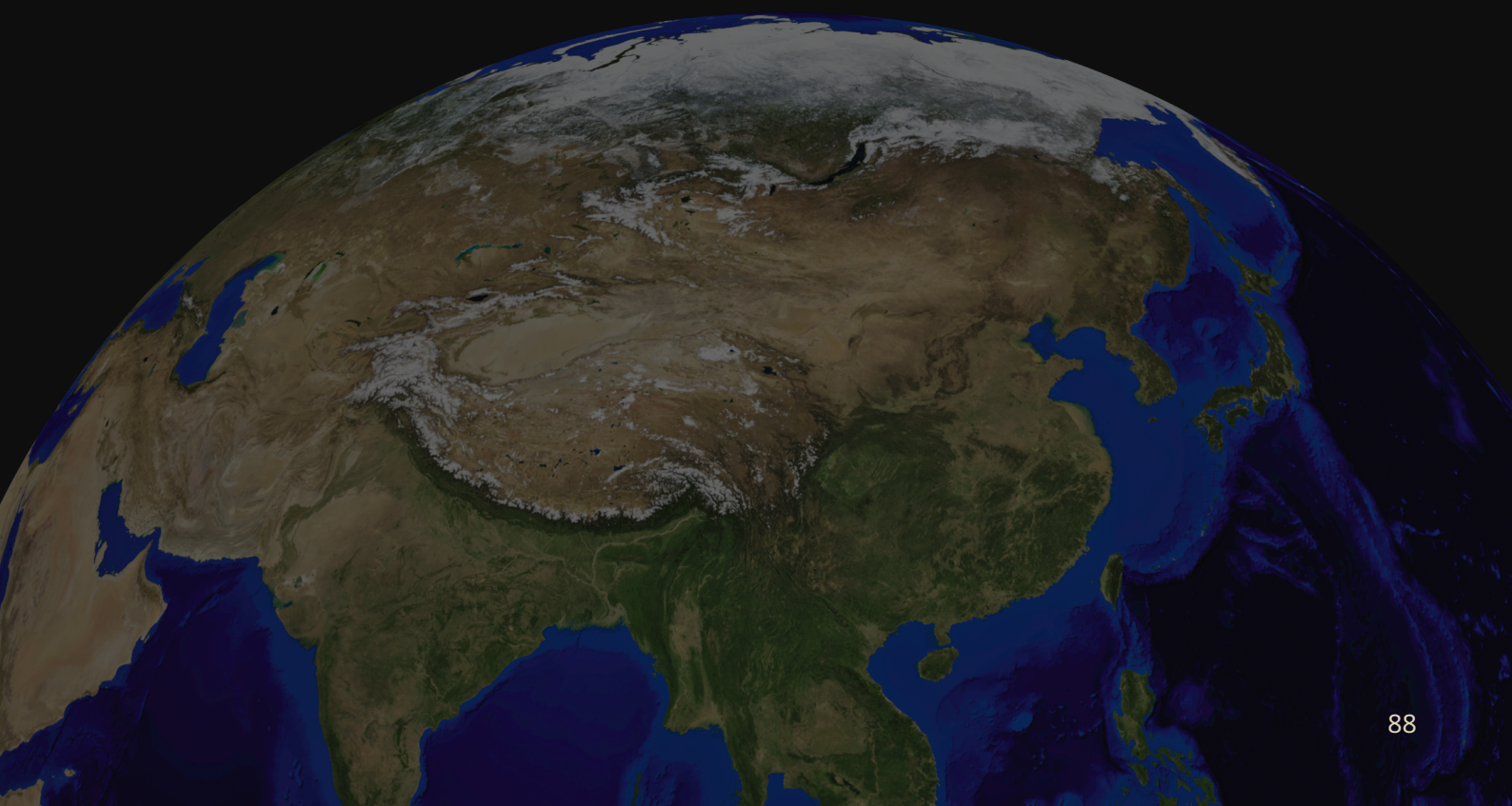
The floods of 2025 weren't just a tragedy. They were a wake-up call, marked by rain, mud, and heartbreak.

Whether we learn from this experience will determine how many more times we have to start over.

Mahnoor Ijaz

A B.S. in Environmental Science graduate at the International Islamic University Islamabad (IIUI), Mahnoor's studies encompass Climate Change, Environmental Chemistry, GIS, and Environmental Management Systems. She has gained critical experience in sustainability and environmental protection through internships with: WWF-Pakistan, The Buraaq Association, Neutrawise,and OGDCL.

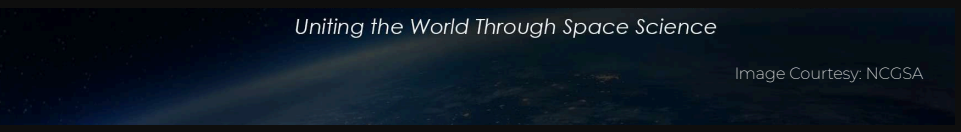
Having attended workshops on Sustainable Development Goals, Climate Change, and Water crises in Pakistan, her work regarding the 2025 floods expresses a sincere commitment to advocating for climate resilience and sustainable water management.



NEWS UPDATE

Pakistan Tops World Space Week with 6,570 Events

In 2024, Pakistan achieved the top ranking globally by organizing over 6,000 activities and 6,570 events under the theme "Space & Climate Change," making it the most active country in World Space Week celebrations.



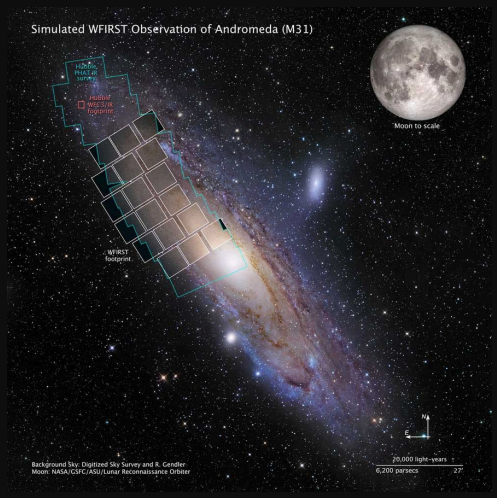
CELESTIAL NETWORKS: APASC 2026

The 4th All Pakistan Asteroid Search Campaign has bridged 140+ students to the cosmos, cementing a growing national legacy of citizen science and planetary discovery.

The APASC News
PAKISTAN'S LARGEST ASTEROID SEARCH CAMPAIGN RETURNS
APASC RETURNS FOR ITS 4TH EDITION
APPLICATIONS OPEN
SCAN THE QR CODE TO APPLY

The Universe Just Got Stranger?

Roman Telescope Will Unlock 95% of the Universe



Launching in late 2026, the Nancy Grace Roman Space Telescope utilizes a field of view 100 times wider than Hubble's to map the dark energy and dark matter that define our cosmic structure.

Interstellar Visitor is Eternal and Erratic in Equal Measure

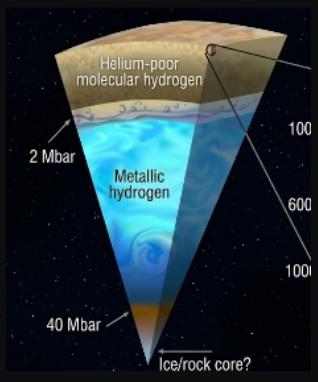
It began beyond our solar system, drifted for eons, swung past our Sun, and is now vanishing into the void. Discovered in July 2025, comet 3I/ATLAS erupted with more carbon dioxide than water—the opposite of normal comets. It later emitted the first-ever interstellar radio signal detected from hydroxyl radicals, completely rewriting the rules. This cosmic runaway carries the chemical signature of a distant sun in its frozen nucleus, physically connecting two star systems and reminding us "how little we actually know".

GHOST IN THE LENS

Astronomers using ALMA have detected a "dark" dwarf galaxy composed almost entirely of dark matter. Hidden within a gravitational lens, this nearly starless void provides a rare blueprint of the invisible scaffolding holding our universe together.

BEAUTIFULLY MESSY

Textbooks claimed Jupiter had a solid center, but Juno data reveals a chaotic, diffuse core—likely shattered by an ancient planetary collision that never quite settled.



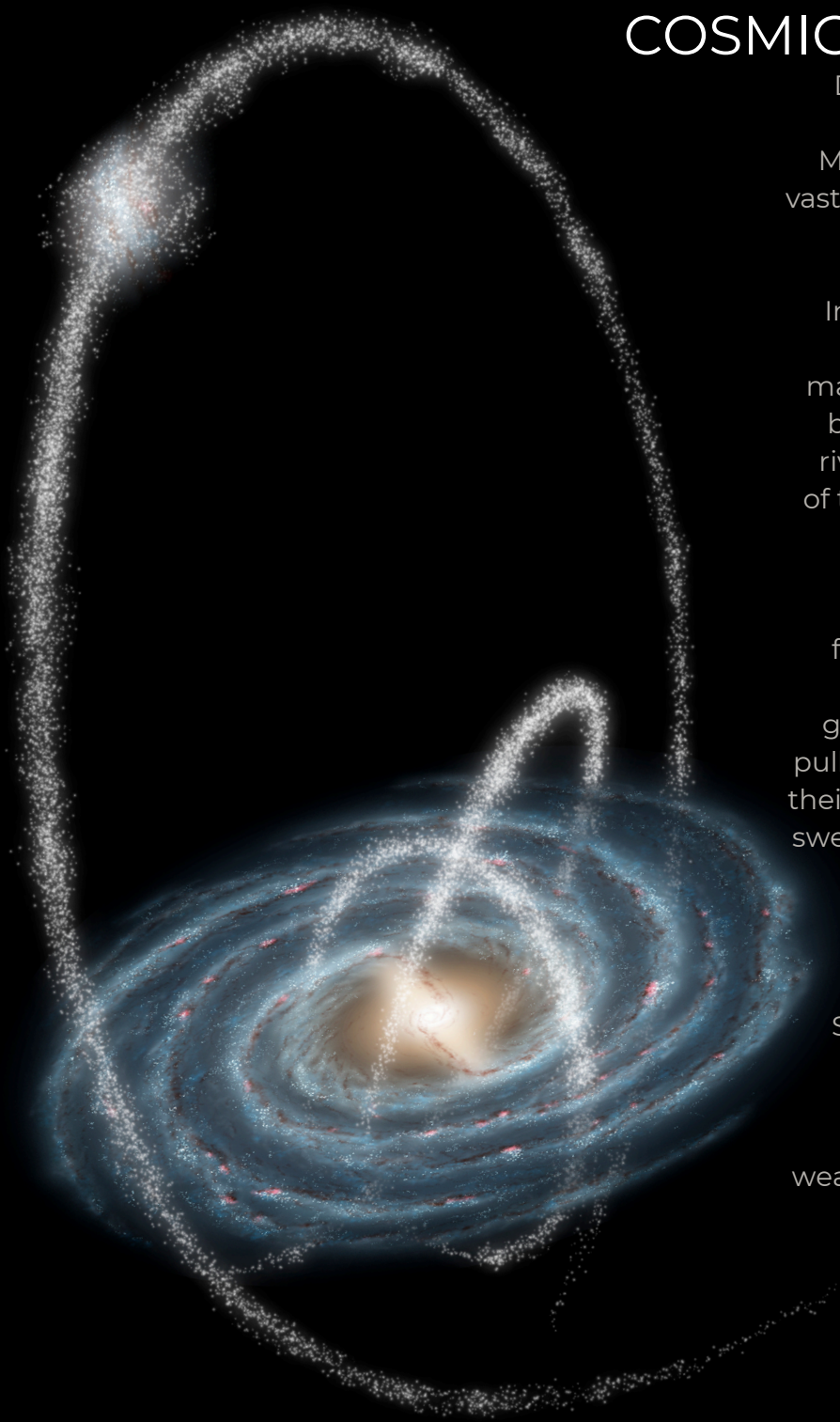
A Pakistani Scientist Found Life's Building Blocks on Saturn's Moon

Dr. Nozair Khawaja, originally from Waziristan, led the discovery of amino acid precursors erupting from Enceladus's hidden ocean. While not yet proof of life, these organic molecules mark a monumental step in understanding the moon's habitability.

The Galaxy Shaped Earth's Crust

Ancient zircon crystals reveal that as our Solar System orbits the Milky Way, its encounters with denser regions, such as spiral arms, may have triggered comet showers that reshaped Earth's crust. The galaxy reached down to touch the ground beneath our feet.

COSMIC HIGHWAYS



Data from the ESA's Gaia mission reveals that the Milky Way is marbled with vast, interconnected threads of stars and gas.

Stars aren't born alone. Instead of forming in tiny, hidden spots in space, massive groups of suns are born inside long, winding rivers of cosmic gas. Think of them like glowing beads strung along a thread thousands of light-years long. As these stellar families drift through the cosmos, massive gravitational forces slowly pull them apart—stretching their tight clusters into long, sweeping ribbons known as "tidal tails."

It's a discovery that fundamentally reshapes how we look at galaxies. Space isn't just a random scatter of stars; it's crisscrossed by invisible highways, constantly weaving and unraveling the sky around us.

Credit: NASA/JPL-Caltech/R. Hurt (SSC/Caltech)

Source: Chains of Starry Gatherings | European Space Agency (ESA)

The New Space Era of Pakistan

After the legacy of Badr-1, iCUBE-1, and PRSS-1, 2024 officially kicked off Pakistan's high-frequency space era. These strides paved the way for the lunar milestones and satellite networks defining our orbital presence today.

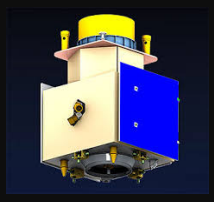
ICUBE-Qamar: Pakistan's First Lunar Leap

On May 3, 2024, Pakistan launched ICUBE-Q from China's Hainan launch site — a 7 kg CubeSat with two cameras that operated in extreme cold below − 100 °C in a selenocentric orbit (200 km to 8,600 km), successfully transmitting striking images of the Sun and Moon, marking Pakistan's debut in deep space, a joint venture between IST, SUPARCO, and, Shanghai Jiao Tong University under APSCO.

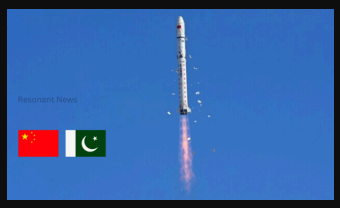
Orbital Watch *The PRSC-EO Constellation*

The PRSC-EO network provides high-frequency monitoring for rapid resource management. Beyond standard imagery, hyperspectral sensors detect minerals, crop stress, and polluted water from orbit—enabling precision agriculture, mining detection, and surgical-grade flood tracking.

PRSC-EO1
1m-resolution mapping.
Launched Jan 17, 2025 | Jiuquan



PRSC-EO2
High-frequency orbital continuity.
Launched Feb 12, 2026 | Yangjiang



PRSC-EO3
AI-driven data processing.
Launched Apr 25, 2026 | Taiyuan

NEXT STOP *Tiangong*

Khurram Daud and Zeeshan Ali are set to make history. One of them will be finalized to launch by late 2026 as a Payload Specialist for orbital research in biotech and physics, establishing Pakistan's physical presence in low Earth orbit.

Simulating microgravity during ACC buoyancy training.

LUNAR FRONTIER: 2028

Pakistan's 35kg indigenous rover joins Chang'e-8 to explore the lunar south pole and bolster ILRS research.

THE CELESTIAL ASCENT

1990	1996	2001	2011	2013	2018	2018	2024	Paksat-MM1 & Multi-Mission	2025
Badr-1 Experimental	Paksat-1 Communications	Badr-B Observation	Paksat-1R Telecomm	iCube-1 Student Sat	PRSS-1 Remote Sensing	PakTES-1A Tech Evaluation	ICube-Q Lunar Orbit		HS-1 Hyper Spectral

OBSERVING HIGHLIGHTS OF 2026

SEPTEMBER 14, 2026 | THE DAYTIME OCCULTATION

THE MOON SWALLOWS VENUS

The Vanishing Planet

A thin crescent moon passes directly in front of brilliant Venus in middaylight (around 11:04–12:21 UTC in Pakistan). The planet hides behind the unlit edge of the lunar disk and emerges an hour later.

Viewing: Using binoculars or a telescope, lock onto the Moon first—and keep your optics safely away from the Sun.

OCTOBER 4, 2026 | THE RINGED OPPOSITION

SATURN AT OPPOSITION

The Golden Giant

Saturn reaches opposition, being directly opposite the Sun from Earth. It shines at its brightest and largest for the year, staying visible all night long. Through a small telescope or steady binoculars, the ring system showing up clearly.

View: Look toward the southern sky after sunset.

DECEMBER 13–14, 2026 | THE WINTER FIREBALLS

GEMINIDS METEOR SHOWER

The Shooting Stars

Widely considered the best meteor shower of the year. The Geminids throw out over 150 multicolored meteors per hour at their peak, featuring bright, slow-moving shooting stars that often burst into vivid colors.

Viewing: Look south after dark.

DECEMBER 23, 2026 | THE WINTER PERIGEE MOON

THE BIGGEST SUPERMOON OF THE YEAR

The Nearest Orbit

The final full moon of the year will orbit closer to Earth than any full moon since 2019, rising with a massive, brilliant presence that dominates the winter night.

Viewing: Watch the eastern horizon at dusk.

Planets: Mars, Jupiter, and the moon align in a straight row on December 25.

THE ‘RED’SPLENDENT MOON

On the night of September 7, 2025, SUPARCO captured a total lunar eclipse as the Moon went completely into Earth's shadow for 82 minutes. From the IST Observatory in Islamabad to rooftops across Pakistan, people gathered with naked eyes and small telescopes to watch the familiar grey disc dim at its edge, blooming slowly into a deep crimson that dressed the entire lunar face in a rich, velvet glow. For over an hour, the Moon stayed suspended in a serene, haunting majesty before the grey quietly returned. The show ended and the familiar face came back, leaving behind a profound awareness of our own tiny scale against the vast, infinite clockwork running above us.

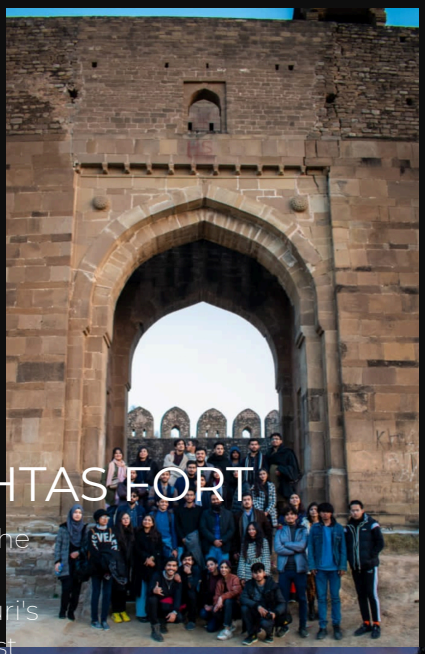
Image Courtesy: SUPARCO

#ASTROWALKS

01 | CHINJI NATIONAL PARK

The raw Salt Range drops into pitch darkness as a sprawling ocean of unshielded cosmic dust overtakes the wilderness.

Image Credits: @Farzzaaam



02 | ROHTAS FORT

Past Jhelum, the 16th-century ramparts of Suri's rugged outpost frame a raw night sky completely unchanged since the fortress walls first rose.

03 | KHABBEKI LAKE

Total blackout. After a daylight trek to Chingi and boating at Khabeki Lake, we stood at a nearby farmhouse for stargazing. Under a myriad of stars as the massive winter moon rose, our tiny earthly scale completely vanished into the overwhelming green fluorescence of Orion.

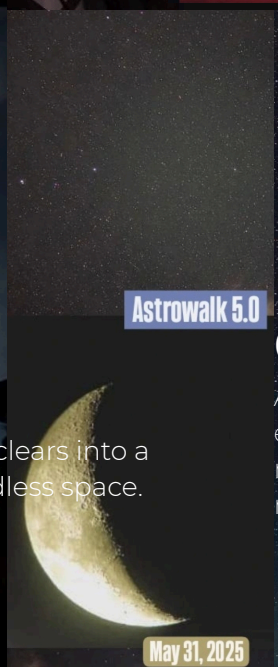
04 | THANDIANI TOP

The grueling summer hike reaches a freezing ridge underthe billion rising suns.

Image Credits: Roshaan's Astrophotography

05 | BATRASI PASS

Past the pine canopy, the grueling trek clears into a sharp summit view falling away into endless space.



06 | TOLI PEER

Above Kashmir's meadows, earthly noise fades as the galaxy's raw core bursts across the silent mountain crest.

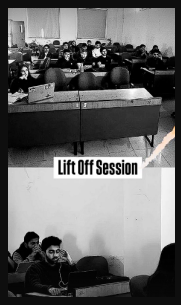
A GLIMPSE AT THE SOCIETY

See the events organised by Space Society from October 2024 to May 2026

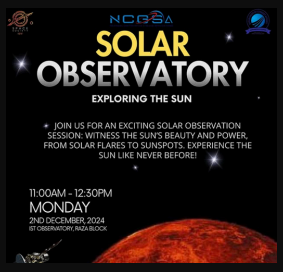
31 October 2024
The Stellar Showcase
An observatory session featuring live telescope observations of Jupiter, Saturn, and the Moon. Participants explored the night sky through IST Observatory's facilities and experienced astronomy firsthand.

November–December 2024
Rocket Propulsion Systems (RPS) Workshop Series A three-part workshop series designed to introduce participants to the fundamentals of rocket propulsion and design. Beginning with OpenRocket software, the series progressed through rocket design principles and hands-on applications, providing participants with both theoretical understanding and practical experience in rocketry.

RPS WORKSHOP #01
INTRODUCTION TO OPEN ROCKET
JOIN US THIS THURSDAY FOR AN ENGAGING RPS WORKSHOP!
PERFECT FOR ALL AGES, THIS FUN AND INTERACTIVE SESSION WILL RUN FROM 3 TO 4 PM. DON'T MISS OUT ON THE CHANCE TO SHARPEN YOUR SKILLS AND ENJOY SOME FRIENDLY COMPETITION. SEE YOU THERE!
VENUE: ROOM 7402, 4TH FLOOR, BLOCK 7
DATE: 07 NOV, 2024
TIME: 03 TO 04PM

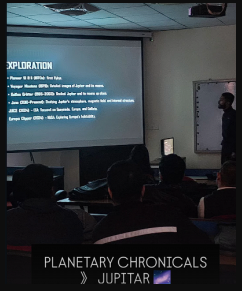


2 December 2024
Solar Observatory: Exploring the Sun
A solar observation session where participants observed solar features including sunspots and solar activity through specialized observational equipment.


NCRSA
SOLAR OBSERVATORY
EXPLORING THE SUN
JOIN US FOR AN EXCITING SOLAR OBSERVATION SESSION! WITNESS THE SUN'S BEAUTY AND POWER, FROM SOLAR FLARES TO SUNSPOTS. EXPERIENCE THE SUN LIKE NEVER BEFORE!
11:00AM - 12:30PM
MONDAY
2ND DECEMBER, 2024
IST OBSERVATORY, RAZA BLOCK

December 2024 – January 2025
Planetary Chronicles Lecture Series
Planetary Chronicles was a three-part educational series that explored the diverse worlds of our Solar System. Through engaging discussions on the Sun and Mercury, Venus and Earth, and finally Mars and Jupiter, participants gained insight into planetary formation, evolution, and the unique characteristics that define our celestial neighbors. The final session was held in collaboration with Stellar Showcase 2.0, combining scientific discussion with live astronomical observation.

PLANETARY CHRONICLES
A Journey Through the Solar System
This is the first lecture of a 5-part series where we'll delve into the facts about Solar System
Session 1: Sun and Mercury
Date: Mon 09, Dec Time: 1:00-2:00 PM
Venue: Room#7401 (Block 7)



8–9 May 2025
Astrophotography Workshop
A two-day workshop introducing participants to astronomical imaging, data acquisition through telescopes, and image processing techniques.

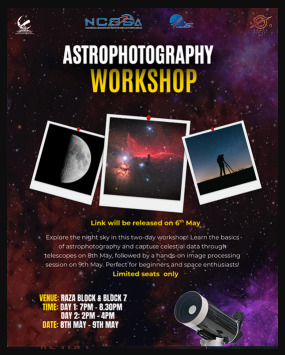
17 October 2025
Space Theatre: Live in Space
An immersive educational event designed to bring participants closer to the realities of human spaceflight and space exploration through interactive presentations and discussions.

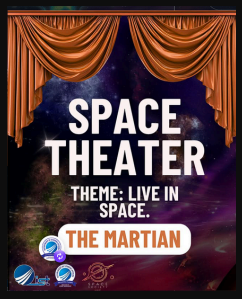
14 November 2025
Cosmic Assembly
A gathering of space enthusiasts featuring discussions, activities, and collaborative engagement centered around astronomy and space science.

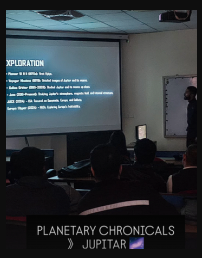
3 March 2026
Eclipse Observation & Discussion Session
Participants observed a celestial eclipse event while engaging in scientific discussions about eclipse mechanics and observational astronomy.

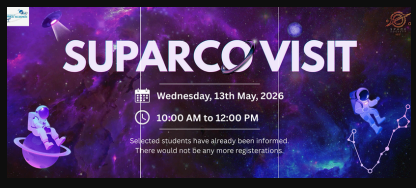
24 February 2026
Celestial Realm
A journey through galaxies, black holes, and the large-scale structure of the Universe, exploring some of the most fascinating phenomena in modern astronomy.

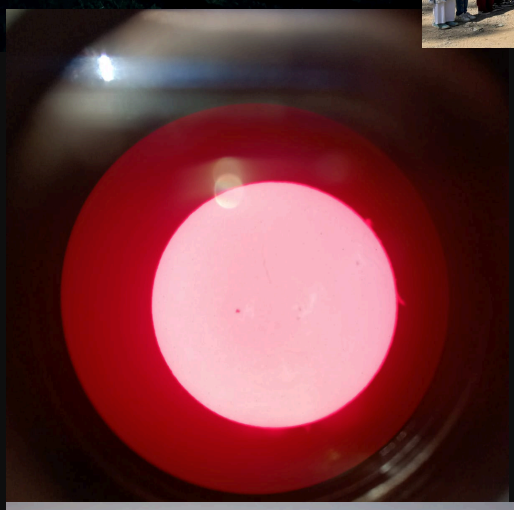
13 May 2026
SUPARCO Visit
An educational visit providing participants with exposure to Pakistan's national space program, satellite technologies, and ongoing space initiatives.

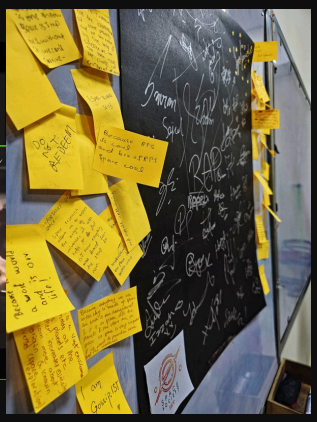

NCOSA
ASTROPHOTOGRAPHY
WORKSHOP
Link will be released on 6th May
Limited seats only
VENUE: RAZA BLOCK & BLOCK 7
TIME: DAY 1: 7PM - 8:30PM
DAY 2: 2PM - 6PM
DATE: 8TH MAY - 9TH MAY






SUPARCO VISIT
Wednesday, 13th May, 2026
10:00 AM to 12:00 PM
Selected students have already been informed.
There would not be any more registrations.





As we wrap up this edition and step away from the editorial desk, we leave the door wide open for you. This magazine is a living reflection of our community, and your feedback, thoughts, and wild ideas are what will truly shape the next volumes and editions that the Space Society IST continues to bring to life.
Drop us a line, share your vision, and let's build the next cosmic journey together!

About Us

The Story Behind Volume Two

When the first volume of The Cosmic Herald came out, it left behind a quiet energy that just felt like it shouldn't stop. It was never about creating a magazine to become famous or widely known; things like this are made for a much simpler, deeper reason. If even a single pair of eyes looks through these pages, connects with the ideas, and finds their own curiosity sparked, then every single hour of day and night work has been paid off.

The pull to step up and keep this project going was instant. Volume Two is just our honest attempt to build on what the previous students started—moving from that initial spark into more grounded, thoughtful pieces about satellite systems, planetary defense, and how space actually ties back to our everyday lives here on Earth. We are here simply because the groundwork laid before us was too meaningful to let it stop.

Contact Us

Reach the Team

For submissions, inquiries, or to write for future issues, feel free to drop us a line:
Email: spacesocietyist6@gmail.com
Linkedin: Space Society IST
facebook: Space Society IST
Instagram: spacesocietyist

Share Your Thoughts

A magazine only completely comes to life when someone reads it. We would love to hear your honest thoughts, critiques, or personal reflections on Volume Two.
Access Volume Two Response Portal:

https://forms.gle/oKey943uSZJa6Mqy6

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Page 12: Detailed Lunar Observation (NDTV)
Page 15: Pale Blue Dot Legacy Portfolio (WIRED)
Page 21: Cal Events Collection (The Getty Museum)
Page 27 & 28: Hypothetical Boötes Void Observation (r/Astronomy via Reddit)
Page 51: Quantum Entanglement Concept (Shutterstock)
Page 58: Top image: NatGeo / Other visuals: DeepAI (Sourced locally within article)
Page 63 & 65: Milky Way Galaxy Over a Road (Unsplash), Images by Haider Taqveen
Page 77: Roman Space Telescope: Dark Matter (NASA Science)
Page 79: Dark Matter Cosmic Web Filaments (Space.com)
Page 81: Solar System Interactive Compare (NASA Solar System)
Pages 85–87: Economic Impact Assessment (Business Recorder)
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